MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

AIR QUALITY ANNUAL REPORT

2019

Michigan Department of Environment, Great Lakes, and Energy
Michigan.gov/EGLE | 800-662-9278

Air Quality Annual Report

2019

Executive summary

This report gives an overview of the air quality for 2019. Current data for Michigan can be found on MIAir (www.deqmiair.org) and Air Quality alerts can be delivered directly to email by signing up for the Michigan EnviroFlash program (http://miair.enviroflash.info/). In April 2019, by the Governor's executive order, the Michigan Department of Environmental Quality (MDEQ) became the Michigan Department of Environment, Great Lakes, and Energy (EGLE). While the data in this report was partly collected in 2019 under the agency name of MDEQ, this report will use EGLE.

The federal Clean Air Act (CAA) requires the United States Environmental Protection Agency (USEPA) to establish National Ambient Air Quality Standards (NAAQS) for six criteria pollutants considered harmful to public health and the environment.

The six pollutants monitored by EGLE, Air Quality Division (AQD) are:

1. Carbon monoxide (CO)
2. Lead (Pb)
3. Nitrogen dioxide (NO_2)
4. Ozone (O_3)
5. Particulate matter smaller than 10 and 2.5 microns in diameter (PM_{10} and $PM_{2.5}$, respectively)
6. Sulfur dioxide (SO_2)

EGLE has established a network of more than 40 monitoring sites throughout the state that monitor for one or more of the criteria pollutants (Figure 1.1 and Table 1.3).

Congress passed the CAA in 1970; however, Michigan has had a long-standing history of environmental awareness well before the Act was established. In 1887, Detroit was the first city in Michigan to adopt an air quality ordinance, which declared that the dense smoke from burning coal was a public nuisance.

The USEPA reviews the criteria pollutant standards every five years. Over time, based upon health data, the standards have been tightened to better protect public health (see Appendix D). Areas that meet the NAAQS are considered in "attainment." Locations where air pollution levels persistently exceed the NAAQS may be designated as "nonattainment." The tightening standards are why some areas in the state may be designated to nonattainment from attainment even though monitoring shows that air quality continues to improve.

Attainment Status for the National Ambient Air Quality Standards

Since EGLE began monitoring in the early 1970s, criteria pollutant levels have continually decreased (see Chap. 2-7). The air is much cleaner today than when the CAA began. The entire state of Michigan is in attainment for CO, Pb, NO_2, and particulate matter. Although portions of the state are in nonattainment for SO_2 and O_3, as illustrated in the figure below, levels of these pollutants are still decreasing. The NAAQS levels have also decreased recently, which prompted these nonattainment areas. EGLE is currently working on State Implementation Plans (SIPs) to reduce pollutants further and bring the entire state into attainment for SO_2 and ozone.

Several changes to the monitoring network occurred during 2019.

- Five sites were shut down: Livonia, Linwood, and Wyandotte to reduce workload; the Eliza Howell Downwind site since it is not needed for the near-road network; and Sault St. Marie, a tribal site, due to discontinued federal funding.
- Lead monitoring at Belding-Reed Street was discontinued since Belding is now in attainment for lead and a second site is no longer needed there (Belding-Merrick Street still monitors for lead). However, meteorological monitors continue at this site (Chap. 3).
- $PM_{2.5}$ Speciation and EC/OC were shut down at Tecumseh to reduce workload and because the data are not required (Chap. 7).
- Several changes were made to the $PM_{2.5}$ network, exchanging Federal Reference Method (FRM) manual filter-based monitors for continuous, federal equivalent method (FEM) monitors, the beta attenuation monitors (BAMs) due to funding changes. Sites that were affected were Tecumseh, Ypsilanti, Eliza Howell Near-road, Bay City, Houghton Lake, Holland, Seney, and Flint (Chap. 7).
- The Livonia Near-road monitor is in the process of moving since site access was lost in July 2019.
- The NOx monitor at E. 7 Mile was switched to an NOy and a NOx monitor was added to Jenison.
- Sampling continues for the Gordie Howe International Bridge project special study.

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INTRODUCTION

Air quality regulations in Michigan are based on National Ambient Air Quality Standards (NAAQS) established by United States Environmental Protection Agency (USEPA) based on the federal Clean Air Act (CAA). The NAAQS designates six criteria pollutants considered harmful to public health and the environment. The USEPA must describe the characteristics and potential health and welfare effects for these criteria pollutants. These standards define the maximum permissible concentration of criteria pollutants in the air (see Table 1.1).

The Michigan Department of Environment, Great Lakes, and Energy (EGLE), Air Quality Division (AQD) monitors the six criteria pollutants, which are:

- Carbon monoxide (CO);
- Lead (Pb);
- Nitrogen dioxide (NO_2);
- Ozone (O_3);
- Particulate matter smaller than 10 and 2.5 microns in diameter (PM_{10} and $PM_{2.5}$, respectively); and
- Sulfur dioxide (SO_2).

Chapters 2 through ***7*** provide information on each of the six criteria pollutants and include:

- Michigan's monitoring requirements for 2019;
- Attainment / nonattainment status;
- Monitoring site locations (tables and maps show all the monitors active in 2019); and
- Air quality trends from 2014-2019 broken down by location.[1]

The 2019 data for each criteria pollutant is available in **Appendix A.**

The AQD also monitors air toxics. Air toxics are other hazardous air pollutants that can affect human health and the environment.[2] This data can be found in **Appendix B.**

The purpose of this report is to provide a snapshot of Michigan's 2019 air quality data, air quality trends, overview of the monitoring network (available in much greater detail in the 2019 Network Review),[3] air toxics monitoring program, and other AQD programs, such as MIair and the Emissions Inventory.[4]

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[1] Air quality trends are based on actual statewide monitored readings, which are also listed in the USEPA's Air Quality Subsystem Quick Look Report Data at www3.epa.gov/airtrends/ .

[2] An Overview of Michigan Air Toxic Rules is available on the AQD website at www.michigan.gov/air (select "Permits," then "Toxics Laws and Rules.")

[3] Available online at www.michigan.gov/documents/deq/deq-aqd-amu-2019_air_monitoring_network_review__623679_7.pdf

[4] Online information about criteria pollutants and air toxics, along with this and previous Annual Air Quality Reports, are available via the AQD's website at www.michigan.gov/air (select "Monitoring").

CHAPTER 1: BACKGROUND INFORMATION

This section summarizes the development of the NAAQS (see **Appendix D** for further details) and how compliance with these standards is determined. Also included is an overview of Michigan's air sampling network, attainment status of the state, and information on MIAir and the Air Quality Index (AQI).

National Ambient Air Quality Standards (NAAQS)

Under the CAA, the USEPA established a primary and secondary NAAQS for each criteria pollutant. The primary standard is designed to protect public health with an adequate margin of safety, including the health of the most susceptible individuals in a population, such as children, the elderly, and those with chronic respiratory ailments. Secondary standards are chosen to protect public welfare (personal comfort and well-being) and the environment.

In addition, the NAAQS have various averaging times to address health impacts. Short averaging times reflect the potential for acute (immediate) effects, whereas long-term averaging times are designed to protect against chronic (long-term) effects.

NAAQS have been established for CO, Pb, NO_2, particulate matter (PM), O_3, and SO_2. **Table 1.1** lists the primary and secondary NAAQS, averaging time, and concentration level for each criteria pollutant in effect in 2019. The concentrations are listed as parts per million (ppm), micrograms per cubic meter (µg/m^3), and/or milligrams per cubic meter (mg/m^3).

Table 1.1: NAAQS in Effect during 2019 for Criteria Pollutants

Pollutant	Primary (health) Level	Primary Averaging Time	Secondary (welfare) Level	Secondary Averaging Time
CO 8-hour average	9 ppm (10 mg/m^3)	8-hour average, not to be exceeded more than once per year *(1971)*	None*	None*
CO 1-hour average	35 ppm (40 mg/m^3)	1-hour average, not to be exceeded more than once per year *(1971)*	None*	None*
Lead	0.15 µg/m^3	Maximum rolling 3-month average *(2008)*	Same as Primary	Same as Primary
NO_2 Annual mean	0.053 ppm (100 µg/m^3)	Annual mean *(1971)*	Same as Primary	Same as Primary
NO_2 1-hour average	0.100 ppm	98th percentile of 1-hour average, averaged over 3 years *(2010)*	Same as Annual	Same as Annual
PM_{10}	150 µg/m^3	24-hour average, not to be exceeded more than once per year over 3 years *(1987)*	Same as Primary	Same as Primary
$PM_{2.5}$ Annual average	12.0 µg/m^3	Annual mean averaged over 3 years *(2012)*	15.0 µg/m^3	Annual mean
$PM_{2.5}$ 24-hour average	35 µg/m^3	98th percentile of 24-hour concentration, averaged over 3 years *(2006)*	Same as Primary	Same as Primary
Ozone	0.070 ppm	Annual 4th highest 8-hour daily max averaged over 3 years *(2015)*	Same as Primary	Same as Primary
SO_2	0.075 ppm	99th percentile of 1-hour daily max averaged over 3 years *(2010)*	0.5 ppm	3 hours

*In 1985, the USEPA revoked the secondary standard for CO (for public welfare) due to a lack of evidence of adverse effects on public welfare at or near ambient concentrations.

Michigan Air Sampling Network

EGLE's AQD operates the Michigan Air Sampling Network (MASN), along with other governmental agencies. For instance, the O_3 and $PM_{2.5}$ monitor in Manistee County is a tribal monitor handled by the Little River Band of Ottawa Indians. A second tribal monitor in Sault Ste. Marie was shut down in February 2019 due to an unrenewed federal grant. Their data is not included in this report, since there are only two months of data. **Figure 1.1** is a picture the deck at the Allen Park site. **Figure 1.2** shows a map of the 2019 MASN monitoring sites.

The MASN consists of federal reference method (FRM) monitors that enable continuous monitoring for the gaseous pollutants CO, NO_2, O_3, and SO_2 providing real-time hourly data. PM and Pb monitors measure concentrations over a 24-hour period. In addition, continuous $PM_{2.5}$ and PM_{10} monitors provide real-time hourly data for PM. $PM_{2.5}$ chemical speciation monitors determine the chemical composition of $PM_{2.5}$. The MASN data is also used to provide timely reporting to EGLE's air quality reporting web page (MIAir). The types of monitoring conducted in 2019 and the MASN locations are shown in **Table 1.3.**

Figure 1.1: Allen Park Site

The **NCore network** began January 1, 2011, as part of the USEPA's 2006 amended air monitoring requirements. NCore is a multi-pollutant network that integrates several advance measurement systems for particles, pollutant gases, and meteorology. Michigan has two NCore sites; Allen Park and Grand Rapids-Monroe Street. Further information on this network is provided in **Chapters 2** through **7**.

The **Near-road Monitoring Network** focuses on vehicle emissions and how they disperse near roadways. Data from these sites are presented in **Chapters 2**, **5**, and **7.**

Figure 1.2: 2019 MASN Monitoring Sites

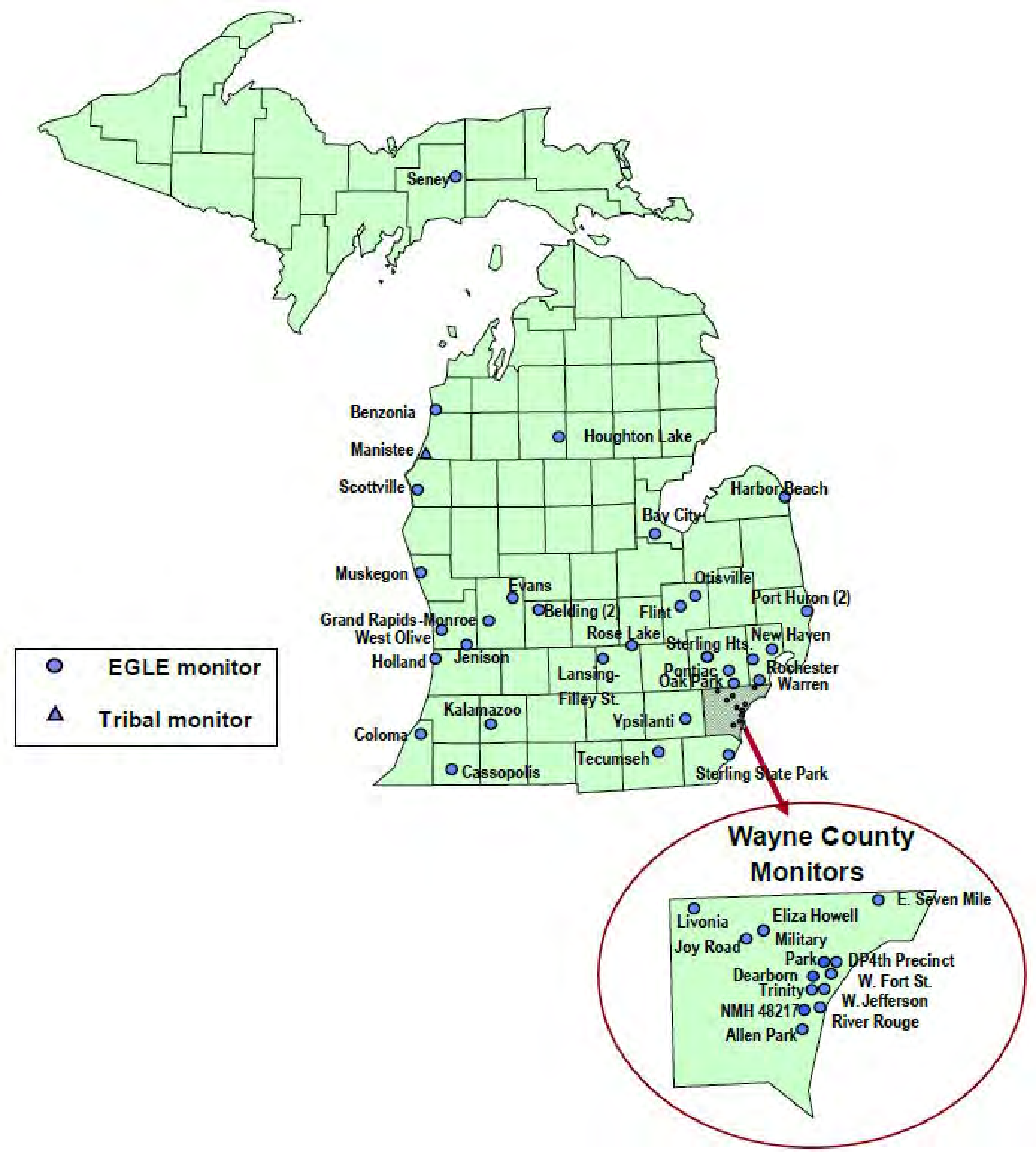


Figure 1.3 Types of Monitoring Conducted in 2019 and MASN Location

Area	AQS ID	Site Name	CO	NO_2	Trace NO_y	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ Continuous	$PM_{2.5}$ Speciation	SO_2	VOC	Carbonyls	Trace Metals&	Wind Speed & Direction, Temp.	Relative Humidity	Solar Radiation	Barometric Pressure
Detroit-Ann Arbor	260910007	Tecumseh				√			√B						√			√
	260990009	New Haven				√		√							√	√	√	
	260991003	Warren				√												
	261250001	Oak Park				√		√							√			
	261470005	Port Huron				√		√	√T		√				√			
	261470031	Port Huron-Rural St.												√				
	261610008	Ypsilanti				√		√	√B						√			√
	261630001	Allen Park	√*		√	√	√	√	√T	√+A	√*			√	√	√		√
	261630005	River Rouge											√	√	√			
	261630015	Detroit-W. Fort St.		√			√	√	√B	√+A	√	√	√	√	√	√		√
	261630019	Detroit-E. 7 Mile			√	√		√							√	√		√
	261630027	Detroit-W. Jefferson												√				
	261630033	Dearborn					√^	√	√T	√+A		√	√	√#	√	√		√
	261630093	Eliza Howell-Roadway	√	√					√B						√			
	261630095	Livonia-Roadway	√	√				√							√	√		√
	261630097	NMH 48217							√T		√			√				
	261360098	GHB-DP4th Precinct	√	√					√B	A	√			√				
	261360099	GHB-Trinity	√	√					√B	A	√			√	√			
	261360100	GHB-Military Park		√					√B	A	√			√				
Flint	260490021	Flint				√		√	√B						√			√
	260492001	Otisville				√									√			
Grand Rapids	261390005	Jenison		√		√	√	√							√			
	261390011	West Olive									√				√			
	260810020	Grand Rapids-Monroe	√*		√	√	√	√	√T	√	√*			√	√			√
	260810022	Evans				√									√			
Lansing/East Lansing	260650018	Lansing-Filley St.		√		√		√	√T		√				√			√
	260370002	Rose Lake				√												
Monroe Co	261150006	Sterling State Park									√				√			
Huron Co	260630007	Harbor Beach				√									√			
Bay Co	260170014	Bay City							√B						√			
Missaukee Co	261130001	Houghton Lake		√		√			√B						√			√
Allegan Co	260050003	Holland				√			√B						√	√	√	√
Benzie Co	260190003	Benzonia				√												
Berrien Co	260210014	Coloma				√									√			
Cass Co	260270003	Cassopolis				√									√			
Kalamazoo Co	260770008	Kalamazoo				√		√	√T						√			
Manistee Co	261010922	Manistee $				√		√							√		√	√
Mason Co	261050007	Scottville				√									√			
Muskegon Co	261210039	Muskegon				√									√			
Schoolcraft Co	261530001	Seney Nat'l Wildlife				√			√B						√	√	√	√
Ionia Co	260670002	Belding-Reed St.													√			
	260670003	Belding-Merrick St.												√				

√ = Data Collected
& = 5 trace metals: As, Cd, Mn, Ni and Pb
# = 9 additional metals sampled: Ba, Be, Cr, Co, Cu, Fe, Mo, V, Zn
B = BAM continuous PM2.5 monitor
T = TEOM continuous PM2.5 monitor
$ = Tribal monitor
* = Trace monitor
^ = Continuous PM10 monitor
A = Aethalometer monitor

Current Attainment Status

Areas of the state that are below the NAAQS concentration level are called attainment areas. The entire state of Michigan is in attainment for the following pollutants:

- CO
- Pb
- NO_2
- Particulate Matter

Nonattainment areas are those that have been classified by the USEPA as having concentrations over the NAAQS level. Portions of the state are in nonattainment for SO_2 and O_3 (see **Figure 1.4**). The SO_2 nonattainment area includes a portion of Wayne County and a portion of St. Clair County. Ozone nonattainment areas include a portion of Allegan County, Berrien County, a portion of Muskegon County and the 7-county area of Southeast Michigan, which includes Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne Counties. Nonattainment status for O_3 was effective on August 3, 2019.

Figure 1.4: Attainment Status for the National Ambient Air Quality Standards

MIair – Air Quality Information in Real-Time

MIair is the internet tool that provides real-time air quality information via EGLE's web page. The deqmiair.org hotlink opens to the current Air Quality Index (AQI) map and displays air quality forecasts for "today" and "tomorrow." **MIair** also hosts EnviroFlash, the automated air quality notification system.

Air Quality Index

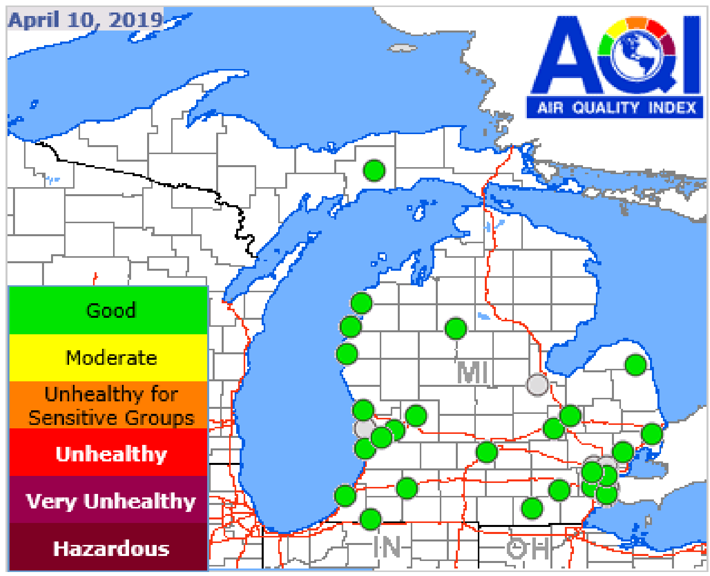
The Air Quality Index (AQI) is a simple tool developed to communicate current air quality information to the public. The current day's color-coded AQI values, ranging from Good to Hazardous (see **Table 1.3**), are displayed in a forecast table and as dots on a Michigan map (see example below).

Latest AQI Information

Select Map: Statewide Go Legend

Location	Current AQI Value	Forecast Today	Forecast Tomorrow
Ann Arbor	19 - O_3	$PM_{2.5}$	$PM_{2.5}$
Benton Harbor	23 - O_3	$PM_{2.5}$	$PM_{2.5}$
Detroit	28 - O_3	$PM_{2.5}$	$PM_{2.5}$
Eastern U.P.	34 - O_3	$PM_{2.5}$	$PM_{2.5}$
Flint	24 - O_3	$PM_{2.5}$	$PM_{2.5}$
Grand Rapids	24 - O_3	$PM_{2.5}$	$PM_{2.5}$
Houghton Lake	28 - O_3	$PM_{2.5}$	$PM_{2.5}$
Kalamazoo	23 - O_3	$PM_{2.5}$	$PM_{2.5}$
Lansing	18 - O_3	$PM_{2.5}$	$PM_{2.5}$
Ludington	28 - O_3	$PM_{2.5}$	$PM_{2.5}$
Saginaw	37 - O_3	$PM_{2.5}$	$PM_{2.5}$
Traverse City	30 - O_3	$PM_{2.5}$	$PM_{2.5}$

AQI Breakpoints Actions To Protect Health



Click on site to display hourly monitor values

As can be seen from the annual summaries in **Appendix C**, air quality in Michigan is generally in the Good or Moderate range. An area will occasionally fall into the Unhealthy for Sensitive Groups range, but rarely reaches Unhealthy levels.

MIair includes an "Air Quality Index Fact Sheet" link: michigan.gov/documents/deq/deq-aqd-aqifacts_273090_7.pdf, which contains activity recommendations based on the AQI levels (also **Table 1.4**).

Air Quality Forecasts

AQD meteorologists provide air pollution forecasts to alert the public when air pollution levels may become elevated. Action! Days are declared when levels are expected to reach or exceed the Unhealthy for Sensitive Groups AQI health indicator. On Action! Days, businesses, industry, government and the public are encouraged to reduce air pollution levels by limiting vehicle use, refueling only after 6 PM, carpooling, walking, biking or taking public transit, deferring the use of gasoline-powered lawn and recreation equipment, limiting the use of volatile chemicals and curtailing all burning. More information on voluntary air pollution control measures can be found under the Action! Days tab on **MIair**.

The weather plays a significant role in air quality (see Chapter 9 for an annual weather summary) and can either help increase or decrease the amount of pollution in the air. High temperatures, sun, and longer days (i.e., more daylight hours) are conducive to ozone formation, whereas rain tends to wash pollutants out of the air. *Action!* Days are declared when meteorological conditions are conducive for the formation of elevated ground-level O_3 or $PM_{2.5}$ concentrations.

Table 1.2 shows that there were some *Action!* Days declared during the summer of 2019.

Table 1.2: *Action!* Days Declared During Summer 2019

Location	Year	Number	Dates
Ann Arbor	2019	5	7/3, 7/15, 7/18, 7/19, 7/20
Benton Harbor	2019	3	7/18, 7/19, 7/20
Detroit	2019	5	7/3, 7/15, 7/18, 7/19, 7/20
Grand Rapids	2019	4	7/15, 7/18, 7/19, 7/20

Air Quality Notification

EnviroFlash is a free service that provides automated air quality (AQI) and ultraviolet (UV) forecasts to subscribers. Those enrolled receive e-mail or mobile phone text messages when the health level they select is predicted to occur. AIRNow iPhone and Android applications deliver ozone and fine particle air quality forecasts plus detailed real-time information that can be used to better protect health when planning daily activities. To learn more about this program, select the **MIair** button from Michigan's Air Quality page www.michigan.gov/air. To receive notices, choose the "Air Quality Notification" tab and click the "Enroll in AQI EnviroFlash" link. Michigan's EnviroFlash network has the potential to reach up to 98% of the state's population.

AIRNow

EGLE supplies Michigan air monitoring data to AIRNow, the USEPA's nation-wide air quality mapping system. Information about AIRNow is available at www.airnow.gov or you can select the AIRNow hot link at the bottom of each **MIair** web page.

Table 1.3: AQI Colors and Health Statements

AQI Color, Category and Value	Particulate Matter ($\mu g/m^3$) 24-hour	Ozone (ppm) 8-hour / 1-hour	Carbon Monoxide (ppm) 8-hour	Sulfur Dioxide (ppm) 24-hour	Nitrogen Dioxide (ppm) 1-hour
GREEN: Good 1- 50	None	None	None	None	None
YELLOW: Moderate 51- 100	Unusually sensitive people should consider reducing prolonged or heavy exertion.	Unusually sensitive people should consider reducing prolonged or heavy exertion.	None	None	None
ORANGE: Unhealthy for Sensitive Groups 101- 150	People with heart or lung disease, children, and older adults should **reduce prolonged** or **heavy** exertion.	People with heart or lung disease, children & older adults, and people who are active outdoors should **reduce prolonged** or heavy exertion.	People with heart disease, such as angina, should limit heavy exertion and avoid sources of CO, such as heavy traffic.	People with asthma should consider limiting outdoor exertion.	None
RED: Unhealthy 151- 200	People with heart or lung disease, children, and older adults should avoid prolonged or heavy exertion. Everyone should reduce prolonged or heavy exertion.	People with heart or lung disease, children & older adults, and people who are active outdoors should **avoid prolonged** or heavy exertion. Everyone should reduce prolonged or heavy exertion.	People with heart disease, such as angina, should reduce moderate exertion and avoid sources of CO, such as heavy traffic.	Children, Asthmatics, and People with heart or lung disease should reduce outdoor exertion.	None
PURPLE: Very Unhealthy 201- 300	People with heart or lung disease, children, and older adults should **avoid all** physical exertion outdoors. Everyone else should limit outdoor exertion.	People with heart or lung disease, children & older adults, and people who are active outdoors should **avoid all** physical exertion outdoors. Everyone else should limit outdoor exertion.	People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic.	Children, asthmatics, and people with heart or lung disease should avoid outdoor exertion. Everyone should reduce outdoor exertion.	Children and people with respiratory disease, such as asthma, should reduce outdoor exertion.
MAROON: Hazardous 301- 500	People with heart or lung disease, children, and older adults should remain indoors. Everyone should **avoid** prolonged or heavy exertion.	People with heart or lung disease, children, and older adults should remain indoors. Everyone should **avoid all** outdoor exertion.	People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic. Everyone else should limit heavy exertion.	Children, Asthmatics, and people with heart or lung disease should remain indoors. Everyone should avoid outdoor exertion.	Children and People with respiratory disease, such as asthma, should avoid outdoor exertion.

CHAPTER 2: CARBON MONOXIDE (CO)

Carbon monoxide is a gas formed during incomplete burning of fuel. CO is colorless, odorless, and tasteless, and is lethal at elevated concentrations. Levels peak during colder months primarily due to cold temperatures that affect combustion efficiency of engines. The CO NAAQS is 9 ppm for the second highest 8-hour average and 35 ppm for the second highest 1-hour average. Its sources and effects are provided below.

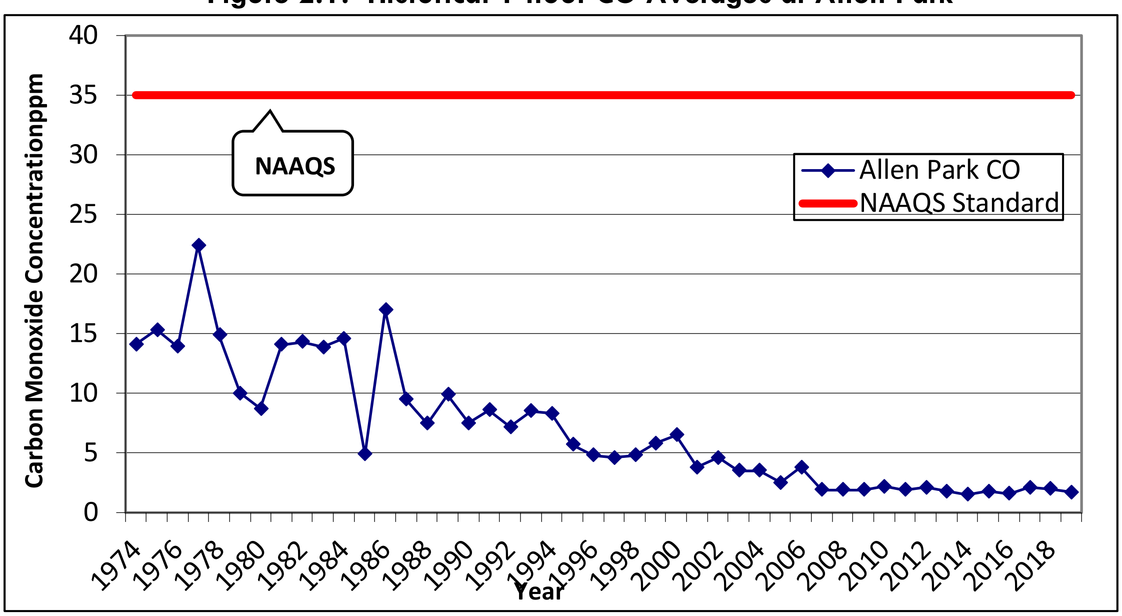
Sources: CO is given off whenever fuel or other carbon-based materials are burned. Outdoor exposure sources include automobile exhaust, industrial processes (metal processing and chemical production), and non-vehicle fuel combustion. Natural sources include volcanos, forest fires and photochemical reactions in the atmosphere. Indoor exposure sources include wood stoves and fireplaces, gas ranges with continuous pilot flame ignition, unvented gas or kerosene heaters, and cigarette smoke.

Effects: CO enters the bloodstream through the lungs, where it displaces oxygen delivered to the organs and tissues. Elevated levels can cause visual impairment, interfere with mental acuity by reducing learning ability and manual dexterity, and can decrease work performance in the completion of complex tasks. In extreme cases, unconsciousness and death can occur. CO also alters atmospheric photochemistry contributing to the formation of ground-level O_3, which can trigger serious respiratory problems.

Population most at risk: Those who suffer from cardiovascular (heart and respiratory) disease, fetuses, infants, and the elderly are most at risk for exposure to elevated levels of CO. People with angina and peripheral vascular disease are especially at risk, as their circulatory systems are already compromised and less efficient at carrying oxygen; however, elevated CO levels can also affect healthy people.

Historical Trends: Southeast Michigan has been monitoring for CO for 45 years. **Figure 2.1** shows the CO trend at Allen Park to be well below the 1-hour standard of 35 ppm. This standard has not changed since 1971.

Figure 2.1: Historical 1-hour CO Averages at Allen Park



Figures 2.2 and **2.3** show CO emission sources and CO emissions by county (courtesy of the USEPA's State and County Emission Summaries).

Figure 2.2: CO Emissions by Source Sector

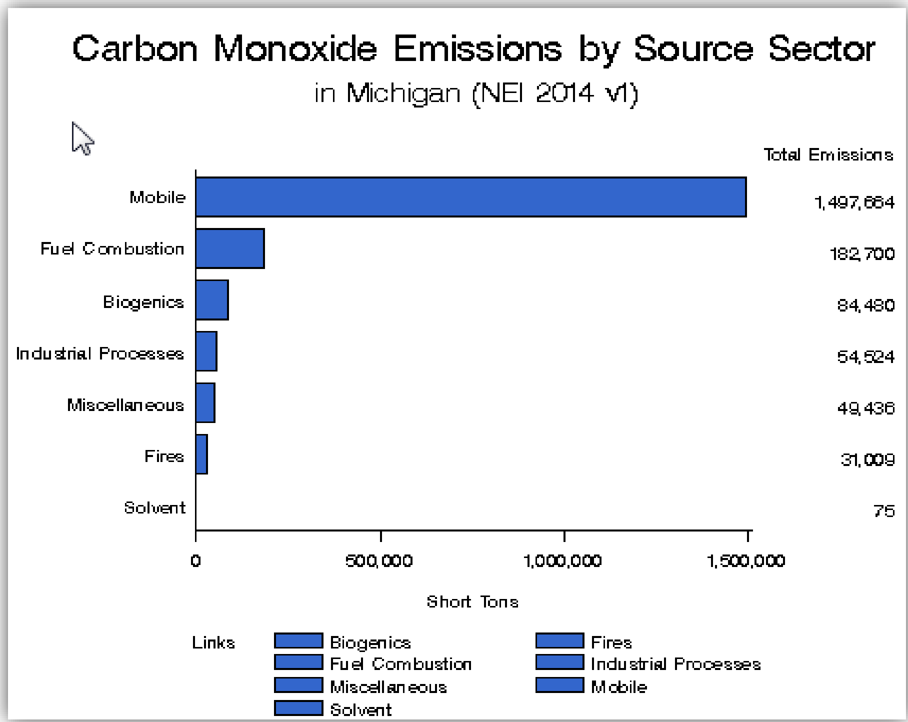


Figure 2.3: CO Emissions in 2014

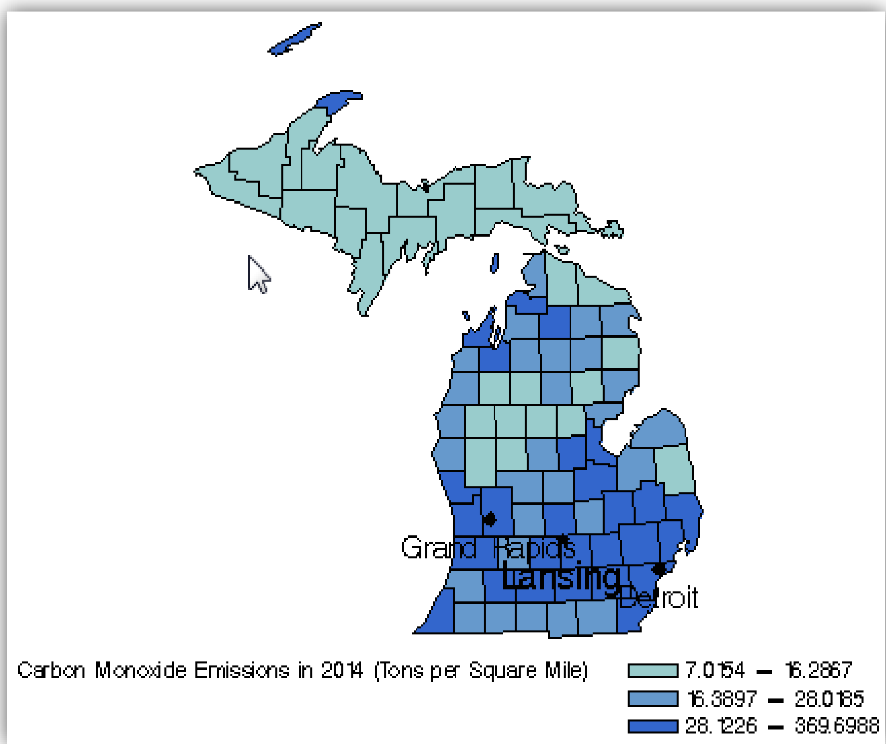


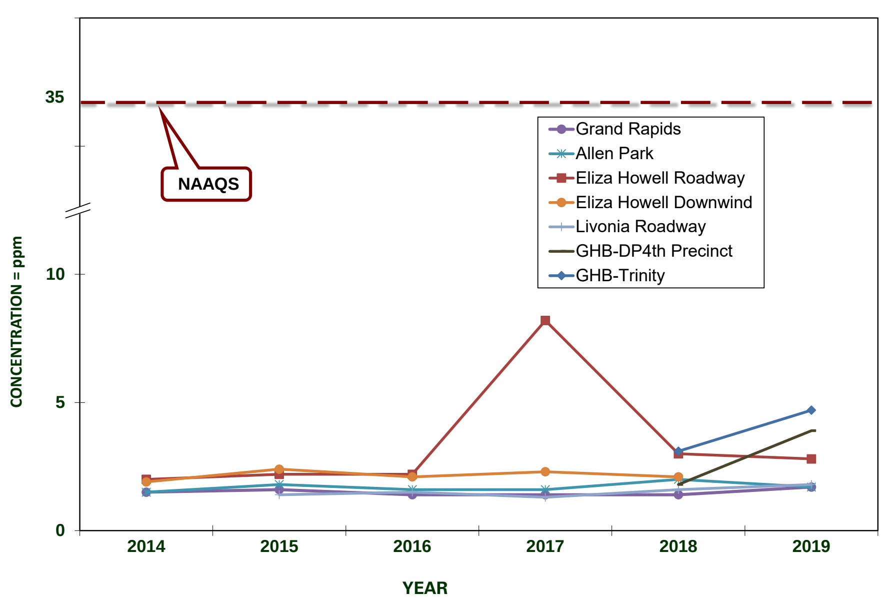
Figure 2.4 shows the location of each CO monitor that operated in 2019.

- Near-roadway network sites: Eliza Howell Park and Livonia.
- NCore Network: Grand Rapids and Allen Park measure trace CO (lower detection levels 1 ppm-50 ppm).
- Gordie Howe International Bridge (GHB) project: Detroit Police 4th Precinct (DP4th Precinct) and Trinity St. Marks (Trinity), started summer and fall 2018, respectively.

Figure 2.4: CO Monitors in 2019

Figure 2.5 shows the second highest 1-hour CO concentrations for Michigan from 2013-2019, which demonstrates that there have not been any exceedances of the 1-hour CO NAAQS.

Figure 2.5: CO Levels in Michigan from 2014-2019 (2nd Highest 1-Hour Maximum Values)



CHAPTER 3: LEAD (PB)

Lead is a highly toxic metal found in coal, oil, and other fuels. It is also found in older paints, municipal solid waste and sewage sludge, and may be released to the atmosphere during combustion. In 2008, the USEPA lowered the Pb NAAQS from a maximum quarterly average of 1.5 $\mu g/m^3$ to a 3-month rolling average of 0.15 $\mu g/m^3$. Its sources and effects are presented below.

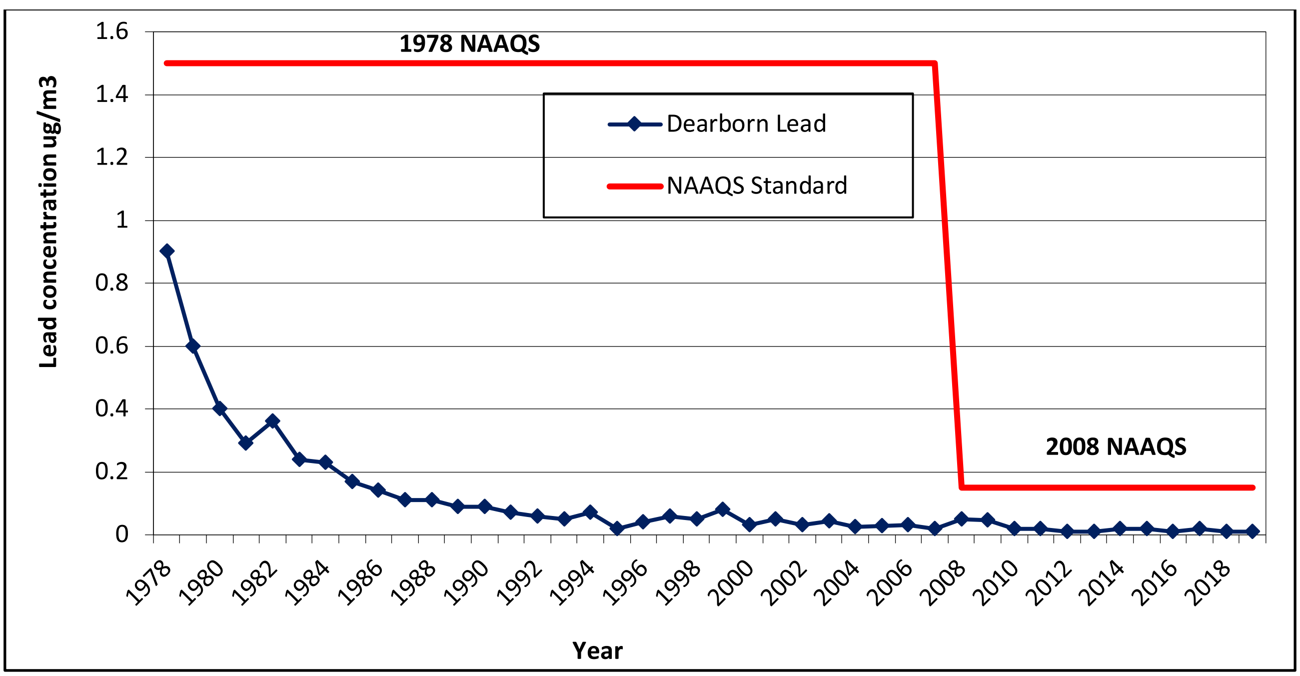
Sources: With the phase-out of leaded gas in the 1970s, the major sources of Pb emissions have been due to ore and metals processing and piston-engine aircraft operating on leaded aviation fuel. Other industrial sources include Pb acid battery manufacturers, waste incinerators, and utilities. The highest air concentrations of Pb are usually found near lead smelters.

Effects: Exposure occurs through the inhalation or ingestion of Pb in food, water, soil, or dust particles. Pb primarily accumulates in the body's blood, bones, and soft tissues, and adversely affects the nervous system as well as the cardiovascular system, reproductive system, blood, kidneys, and other organs.

Population most at risk: Fetuses and children are most at risk since low levels of Pb may cause central nervous system damage. Excessive Pb exposure during the early years of life is associated with lower IQ scores and neurological impairment (seizures, mental development, and behavioral disorders). Even at low doses, lead exposure is associated with changes in fundamental enzymatic, metabolic, and homeostatic mechanisms in the body, and Pb may be a factor in high blood pressure and subsequent heart disease.

Historical Trends: Southeast Michigan has been monitoring for lead for 40 years. **Figure 3.1** shows the trend for lead at Dearborn. The largest decrease in Pb in the air is due to the removal of Pb in gasoline. By 1975, most newly manufactured vehicles no longer required leaded gasoline, and as a result, there was a dramatic decrease in ambient Pb levels. In 1996, the USEPA banned the sale of leaded fuel for use in on-road vehicles. The graph also shows the decrease in the Pb standard that occurred in 2008.

Figure 3.1: Historical Quarterly / 3-month Averages for Lead at Dearborn



Figures 3.2 and **3.3** show Pb emission sources and Pb emissions by county (courtesy of the USEPA's State and County Emission Summaries).

Figure 3.2: Pb Emissions by Source Sector

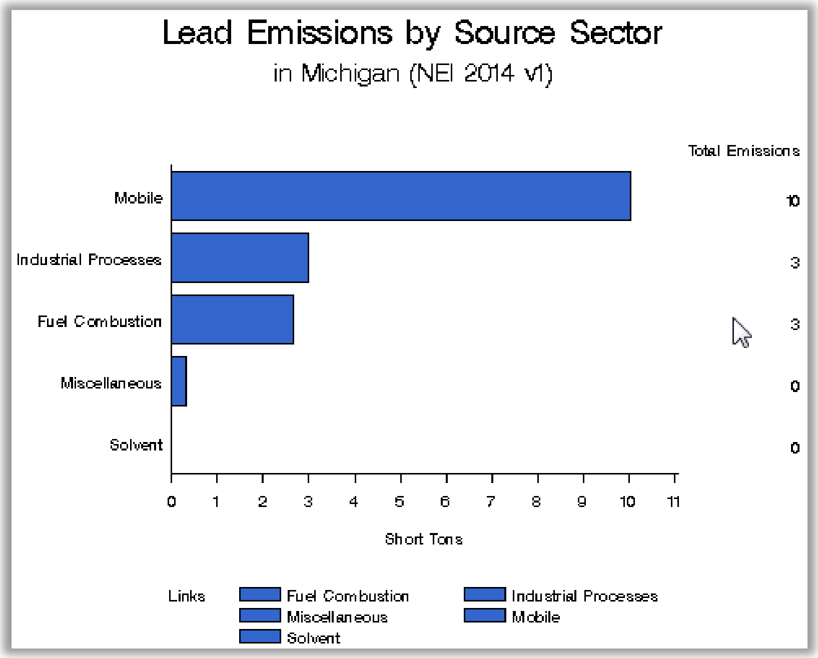


Figure 3.3: Pb Emissions in 2014

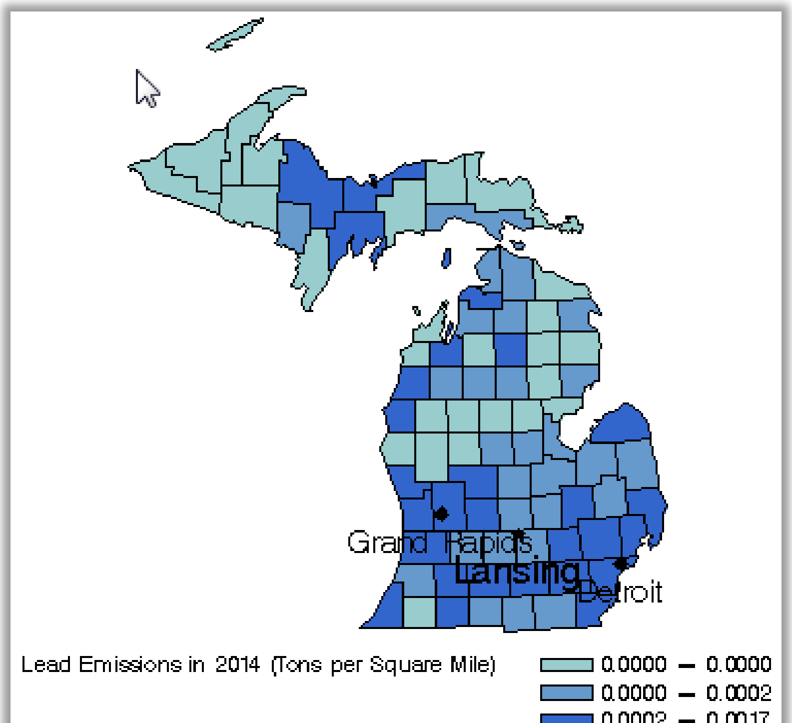


Figure 3.4 shows the location of the Pb monitors in the MASN in 2019. When the Pb NAAQS was lowered in 2008, the monitoring network was modified to consist of source-oriented monitors and population-oriented monitors. As part of the 2008 Pb NAAQS, EGLE must monitor near stationary sources emitting more than 1/2 ton of Pb per year.

- Source-oriented sites: Port Huron-Rural St. and Belding-Merrick St. The second site, Belding-Reed St. was shut down on January 1, 2019, since lead levels are below the standard and both sites are no longer necessary. The two sites in Belding previously were above the standard, but values for both the sites have been below the NAAQS for the past five years. Belding was designated to attainment on July 31, 2018.
- National Air Toxics Trend Sites (NATTS): Dearborn lead and trace metals, both as total suspended particulate (TSP) and PM_{10}. Lead measurements as $PM_{2.5}$ are also made throughout the $PM_{2.5}$ speciation network.
- NCore sites: Allen Park and Grand Rapids.
- Network consistency: River Rouge, Detroit-W. Jefferson, New Mount Hermon (NMH) 48217, and Detroit-W. Fort St. On January 1, 2018, lead sampling was started at all the TSP metals sites to maintain consistency and to be more protective of public health. Many older homes, which often contain lead-based paint, are being demolished in the Detroit area near these monitors.
- Secondary monitor: Port Huron-Rural St. to comply with the USEPA's collocation regulations.
- Gordie Howe International Bridge (GHB) project: DP4th Precinct, Trinity, and Military Park.

Figure 3.4: Lead (Pb) Monitors in 2019

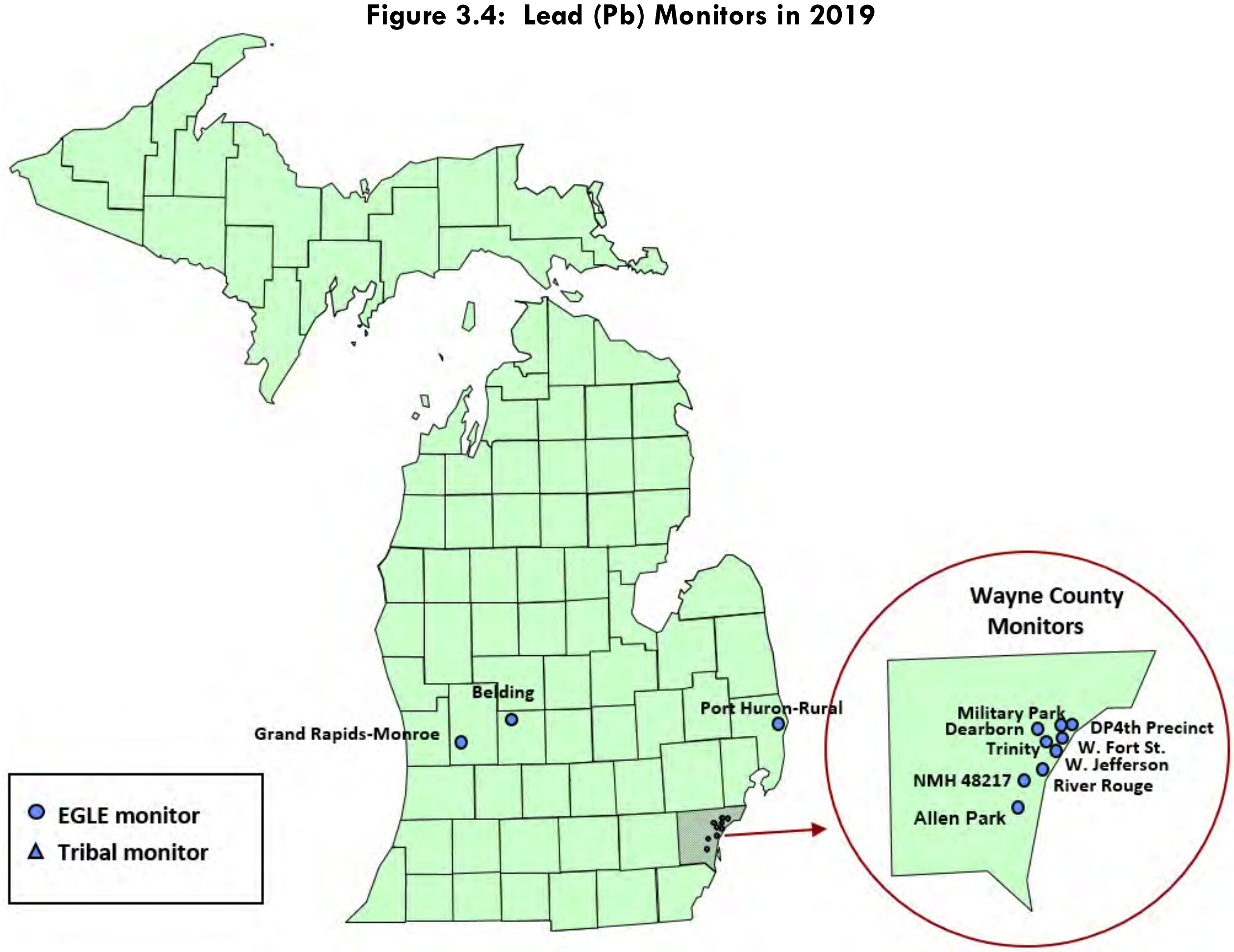
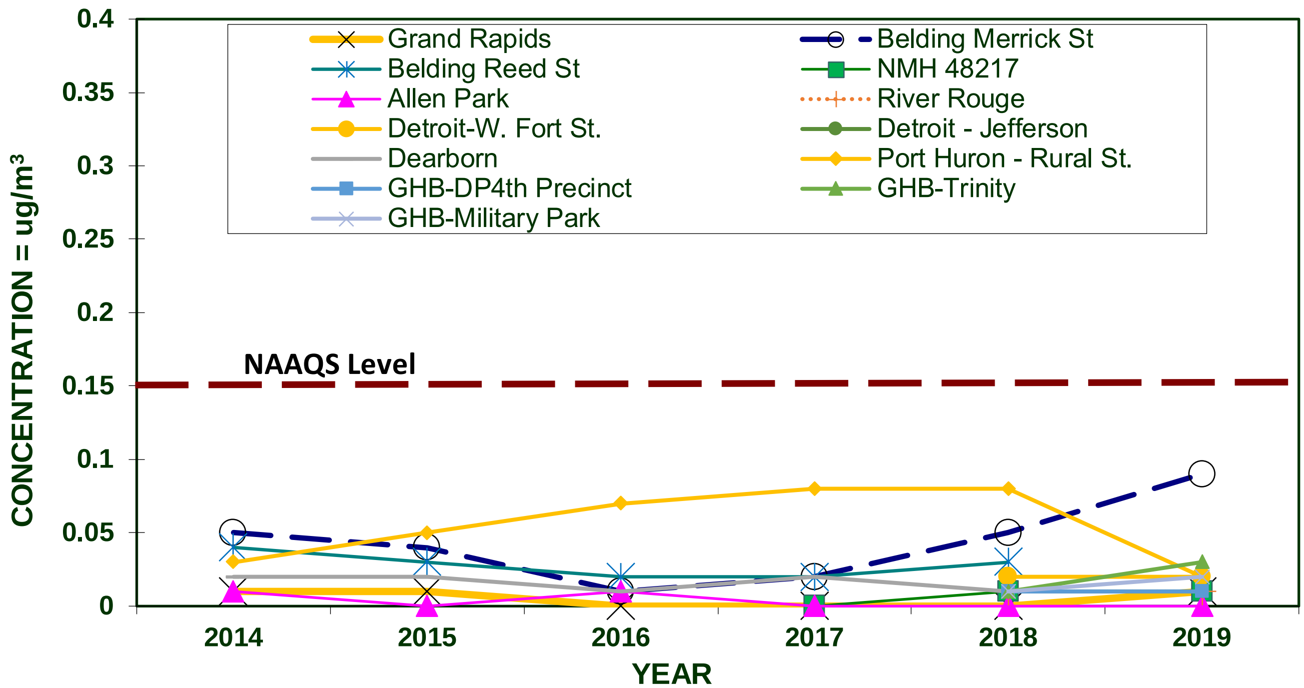


Figure 3.5 shows the maximum 3-month rolling average values for Pb from 2014 to 2019. All Pb monitor sites in Michigan are below the standard.

Figure 3.5: Lead Levels in Michigan from 2014-2019 (Maximum 3-month Average Values)



CHAPTER 4: NITROGEN DIOXIDE (NO_2)

Nitrogen dioxide is a reddish-brown, highly reactive gas formed through oxidation of nitric oxide (NO). Upon dilution, it becomes yellow or invisible. High concentrations produce a pungent odor and lower levels have an odor similar to bleach. NO_X is the term used to describe the sum of NO, NO_2, and other nitrogen oxides. NO_X can lead to the formation of O_3 and NO_2 and can react with other substances in the atmosphere to form particulate matter or acidic products that are deposited in rain (acid rain), fog, or snow. Since 1971, the primary and secondary standard for NO_2 was an annual mean of 0.053 ppm. In January 2010, the USEPA added a 1-hour NO_2 standard of 100 ppb, taking the form of the 98th percentile averaged over three years. The sources and effects of NO_2 are as follows:

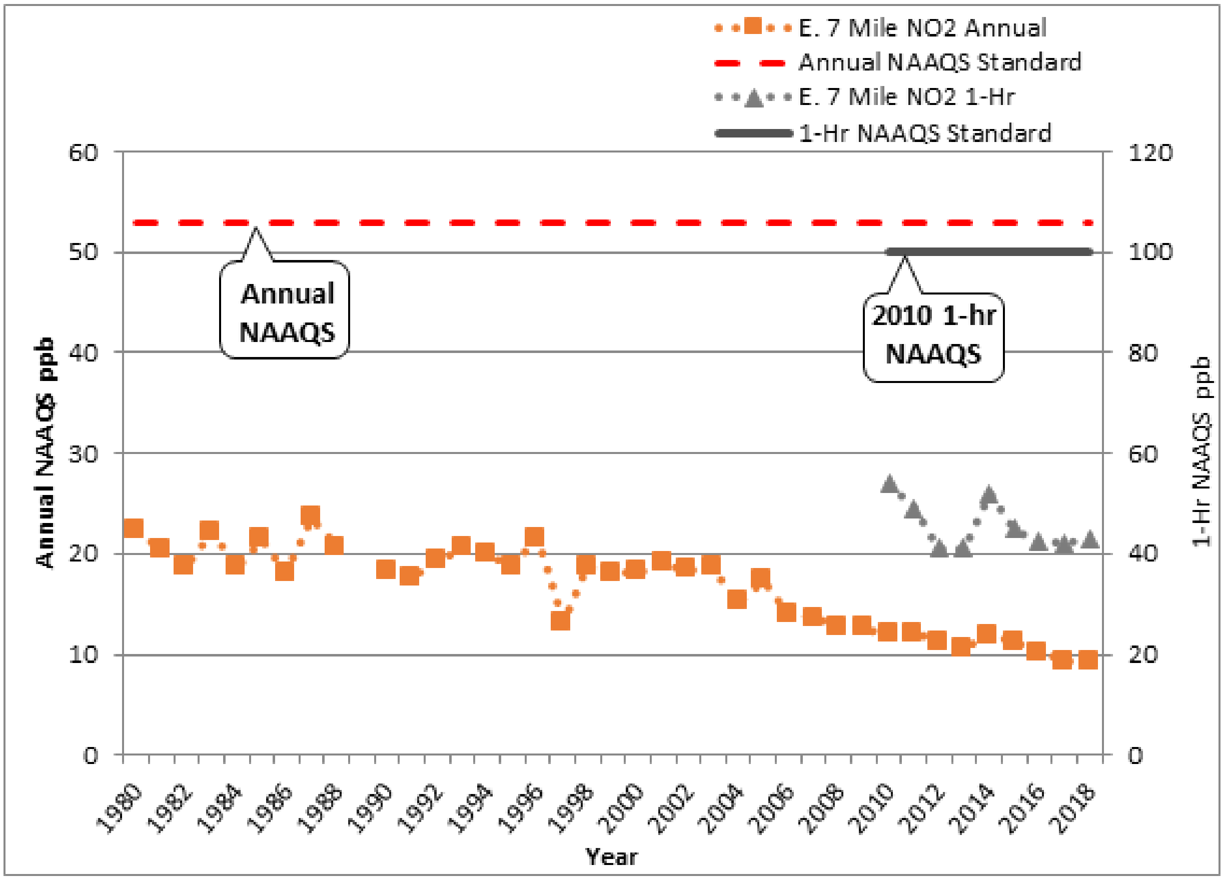
Sources: NO_X compounds and their transformed products occur both naturally and because of human activities. Natural sources of NO_X are lightning, forest fires, bacterial processes in soil, and stratospheric intrusion. Stratospheric intrusion is when the air upper atmosphere (stratosphere) descends towards the surface of the earth and mixes with the air at breathing level. Ammonia and other nitrogen compounds produced naturally are important in the cycling of nitrogen through the ecosystem. The major sources of man-made (anthropogenic) NO_x emissions come from high-temperature combustion processes such as those occurring in automobiles and power plants. Home heaters and gas stoves produce substantial amounts of NO_2 in indoor settings.

Effects: Exposure to NO_2 occurs through the respiratory system, irritating the lungs. Short-term NO_2 exposures (i.e., less than three hours) can produce coughing and changes in airway responsiveness and lung function. Evidence suggests that long-term exposures to NO_2 may lead to increased susceptibility to respiratory infection and may cause structural changes in the lungs. Exercise increases the ventilation rate and hence exposure to NO_2. Nitrate particles and NO_2 can block the transmission of light, resulting in visibility impairment (i.e., smog or haze). Nitrogen deposition can lead to fertilization, excessive nutrient enrichment, or acidification of terrestrial, wetland, and aquatic systems that can upset the delicate balance in those ecosystems.

Population most at risk: Individuals with pre-existing respiratory illnesses and asthmatics are more sensitive to the effects of NO_2 than the general population. Short-term NO_2 exposure can increase respiratory illnesses in children.

Historical Trends: Southeast Michigan has been monitoring for NO_2 for almost 40 years. **Figure 4.1** shows the trend for NO_2 at E. 7 Mile Road, which has been well below the annual standard of 53 ppb and shows a downward trend. In 2010, the USEPA added a 1-hour standard for NO_2, which has also remained well below the standard in Michigan. Southeast Michigan is highly industrialized; therefore, it is a good indicator of the air quality improvement for the rest of the state.

Figure 4.1: Historical Annual and 1-hour NO_2 at E. 7 Mile Road



Figures 4.2 and **4.3** show NO_2 emission sources and NO_2 emissions by county (courtesy of the USEPA's State and County Emission Summaries).

Figure 4.2: NO_2 Emissions by Source Sector

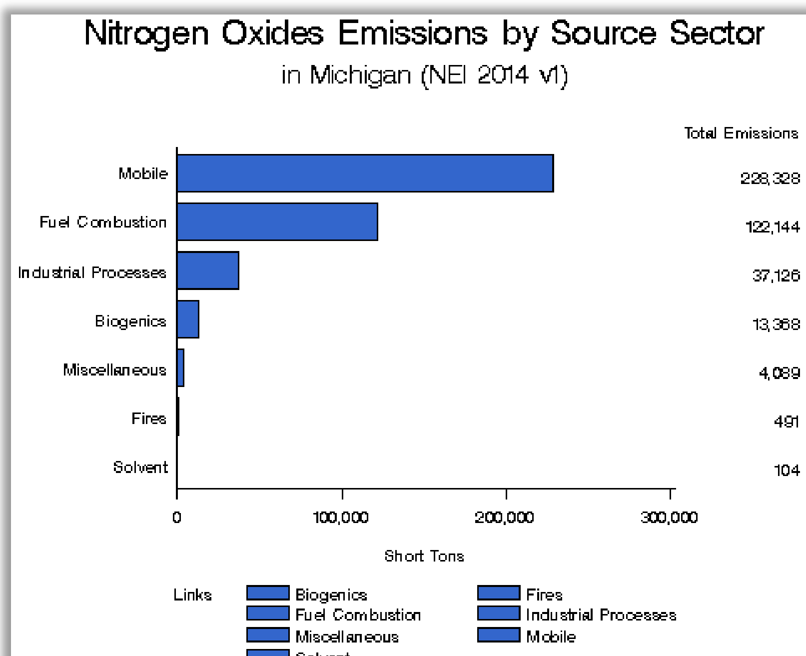


Figure 4.3: NO_2 Emissions in 2014

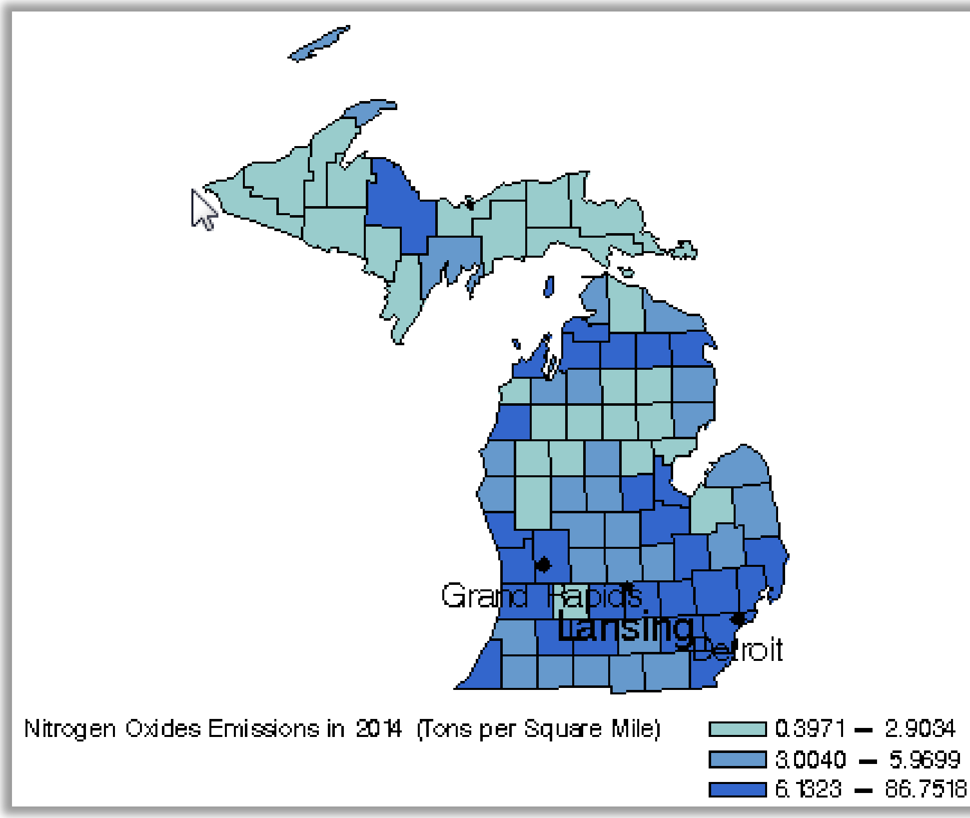
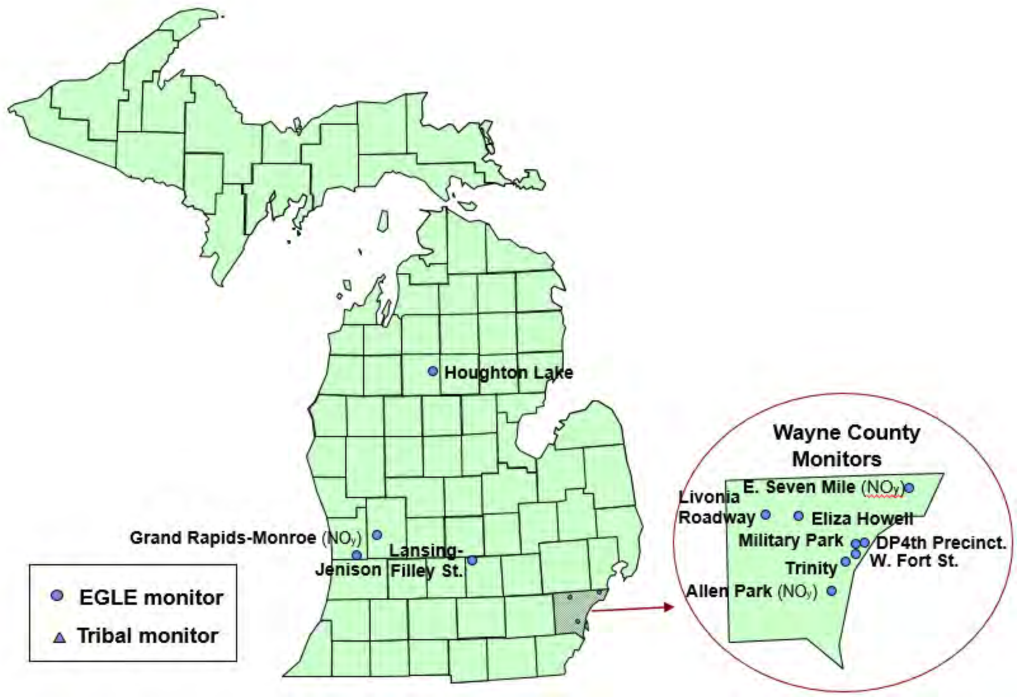


Figure 4.4 shows the location of all NO_2 monitors that operated in 2019.

- Downwind urban scale site: E. 7 Mile in Detroit and Jenison for the Grand Rapids area
- Near-roadway Network sites: Detroit Eliza Howell roadway site, the downwind site was shut down since it is not necessary for the near-road network. The Livonia roadway site needed to be moved since EGLE lost site access. A suitable replacement has not been found.
- NCore sites: Grand Rapids and Allen Park, monitor NO_Y, which includes NO_X, nitric acid and organic and inorganic nitrates (not used for attainment/nonattainment purposes).
- Photochemical Assessment Monitoring Station (PAMS) Network: The NO_X monitor at E. 7 Mile was switched to a NO_Y for PAMS. Direct NO_2 will also be monitored at E. 7 Mile when the PAMS network is completely installed at this site.
- Background monitors for modeling: Lansing and Houghton Lake.
- Gordie Howe International Bridge (GBH) project: W. Fort St., DP4th Precinct, Trinity, and Military Park (GHB)

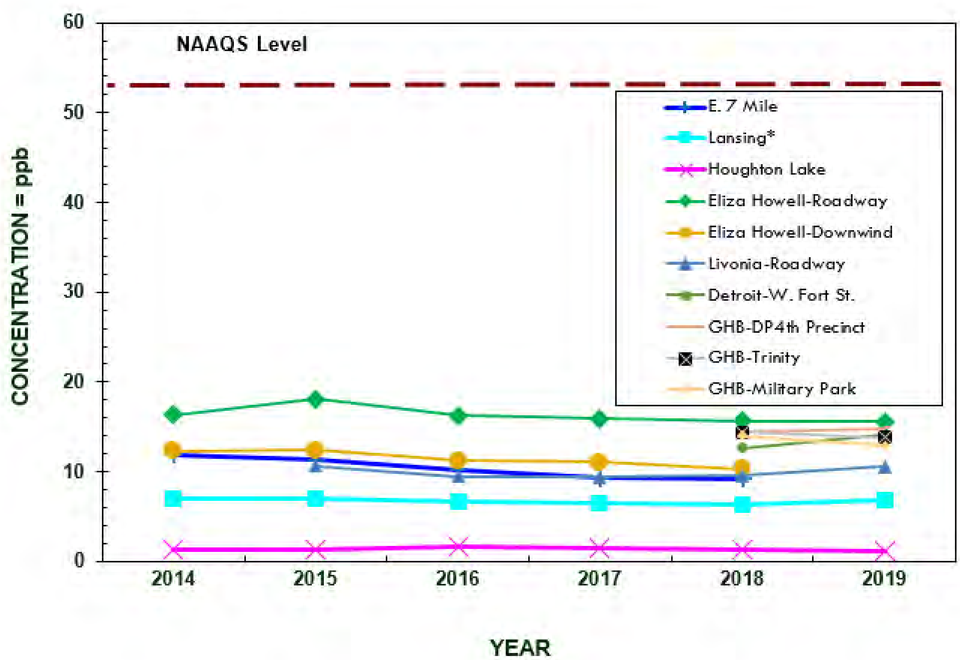
Figure 4.4: Nitrogen Dioxide (NO_2)/NO_Y Monitors in 2019



Michigan's ambient NO_2 levels have always been well below the NAAQS. Since March 3, 1978, all areas in Michigan have been in attainment for the annual NO_2 NAAQS. As shown in **Figure 4.5**, all monitoring sites have had an annual NO_2 concentration at less than half of the 0.053 ppm NAAQS.

Even though there are no nonattainment areas for NO_2 in Michigan and monitoring for attainment purposes is not required, monitors continue to operate to support photochemical model validation work.

Figure 4.5: NO_2 Levels in MI from 2014-2019 (Annual Arithmetic Mean)**



*Indicates site was moved 2018 and concentrations were averaged together for both locations.

**Since Allen Park and Grand Rapids are monitoring NO_Y, those sites are not included in graph.

CHAPTER 5: SULFUR DIOXIDE (SO_2)

Sulfur dioxide is a gas formed by the burning of sulfur-containing material. Odorless at typical ambient concentrations, SO_2 can react with other atmospheric chemicals to form sulfuric acid. At higher concentrations it has a pungent, irritating odor similar to a struck match. When sulfur-bearing fuel is burned, the sulfur is oxidized to form SO_2, which then reacts with other pollutants to form aerosols. These aerosols can form particles in the air causing increases in $PM_{2.5}$ levels. In liquid form, it is found in clouds, fog, rain, aerosol particles, and in surface films on these particles. In June 2010, the USEPA changed the primary SO_2 standard to a 99th percentile of 1-hour concentrations not to exceed 0.075 ppm, averaged over a 3-year period. The secondary standard has not changed and is a 3-hour average that cannot exceed 0.5 ppm once per year. Its sources and effects are presented below.

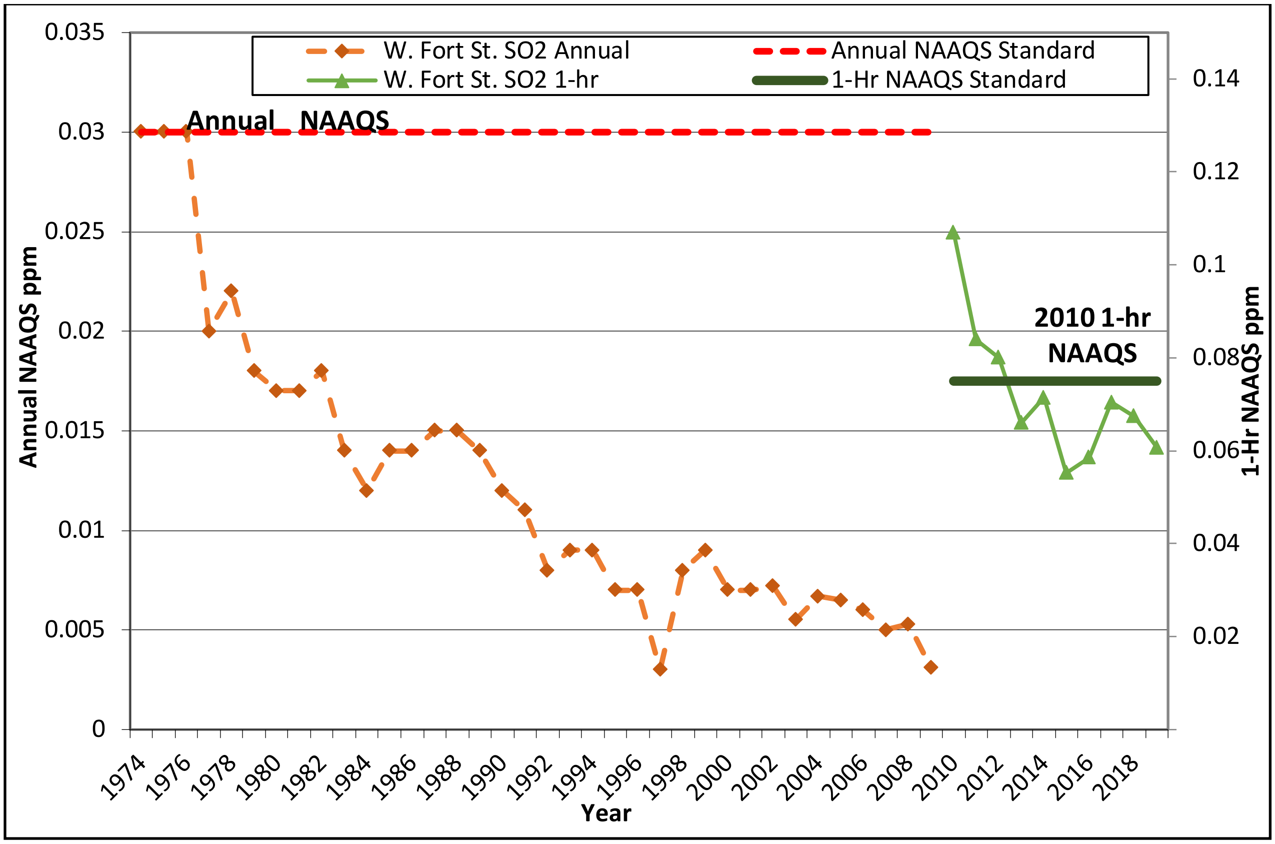
Sources: Coal-burning power plants are the largest source of SO_2 emissions. Other sources include industrial processes such as extracting metal from ore, and non-road transportation sources, and natural sources such as volcanoes. SO_2 and particulate matter are often emitted together.

Effects: Exposure to elevated levels can aggravate symptoms in asthmatics and cause respiratory problems in healthy groups. SO_2 and NOx together are the major precursors to acid rain and are associated with the acidification of soils, lakes, and streams, as well as accelerated corrosion of buildings and monuments.

Population most at risk: Asthmatics, children, and the elderly are especially sensitive to SO_2 exposure. Asthmatics receiving short-term exposures during moderate exertion may experience reduced lung function and symptoms, such as wheezing, chest tightness, or shortness of breath. Depending on the concentration, SO_2 may also cause symptoms in people who do not have asthma.

Historical Trends: Southeast Michigan has been monitoring for SO_2 for 45 years. **Figure 5.1** shows the SO_2 trend for the old annual standard and the new 1-hour standard for W. Fort Street in Detroit. Michigan had been in attainment for SO_2 since 1982 with levels consistently well below the annual SO_2 NAAQS. In 2010, when the USEPA changed the standard from an annual average to a 1-hour standard, a portion of Wayne County was designated nonattainment. In September 2016, a portion of St. Clair County was also designated as nonattainment by the USEPA based on emissions and modeling. Even though the areas are in nonattainment for the 1-hour SO_2 standard, SO_2 concentrations have decreased at these sites and are currently under the NAAQS, although modeling results are not below the NAAQS.

Figure 5.1: Historical Annual and 1-hour SO_2 Averages at W. Fort St.



Figures 5.2 and **5.3** show SO_2 emission sources and SO_2 emissions by county (courtesy of the USEPA's State and County Emission Summaries).

Figure 5.2: SO_2 Emissions by Source Sector

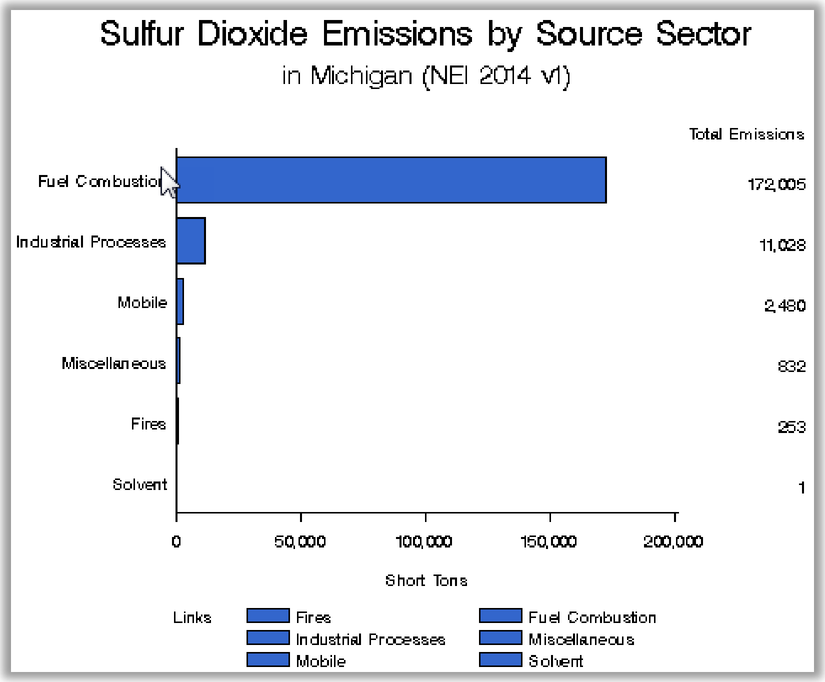


Figure 5.3: SO_2 Emissions in 2014

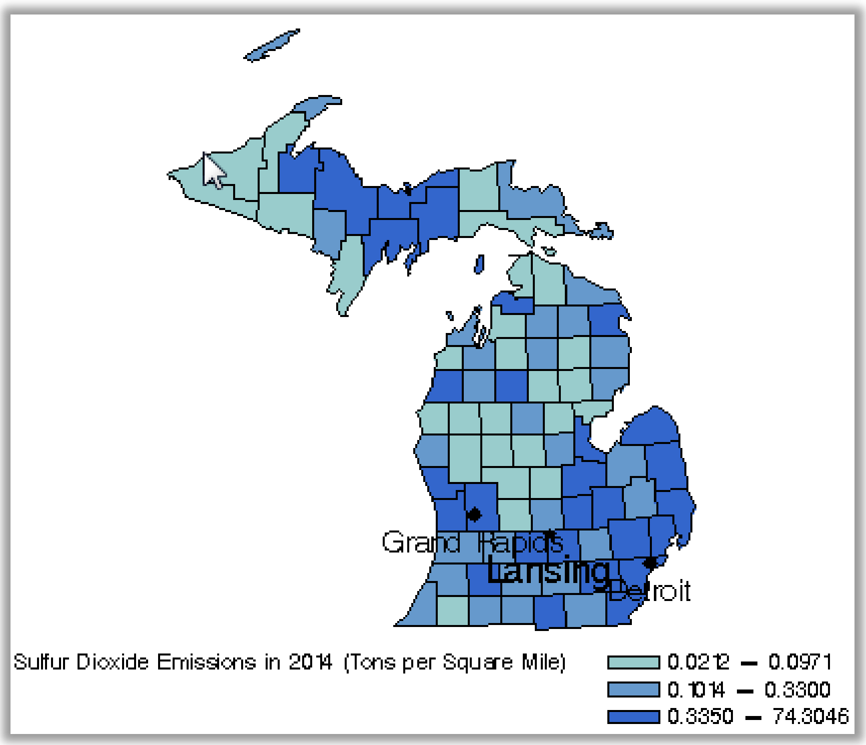


Figure 5.4 shows the location of each SO_2 monitor that operated in 2019.

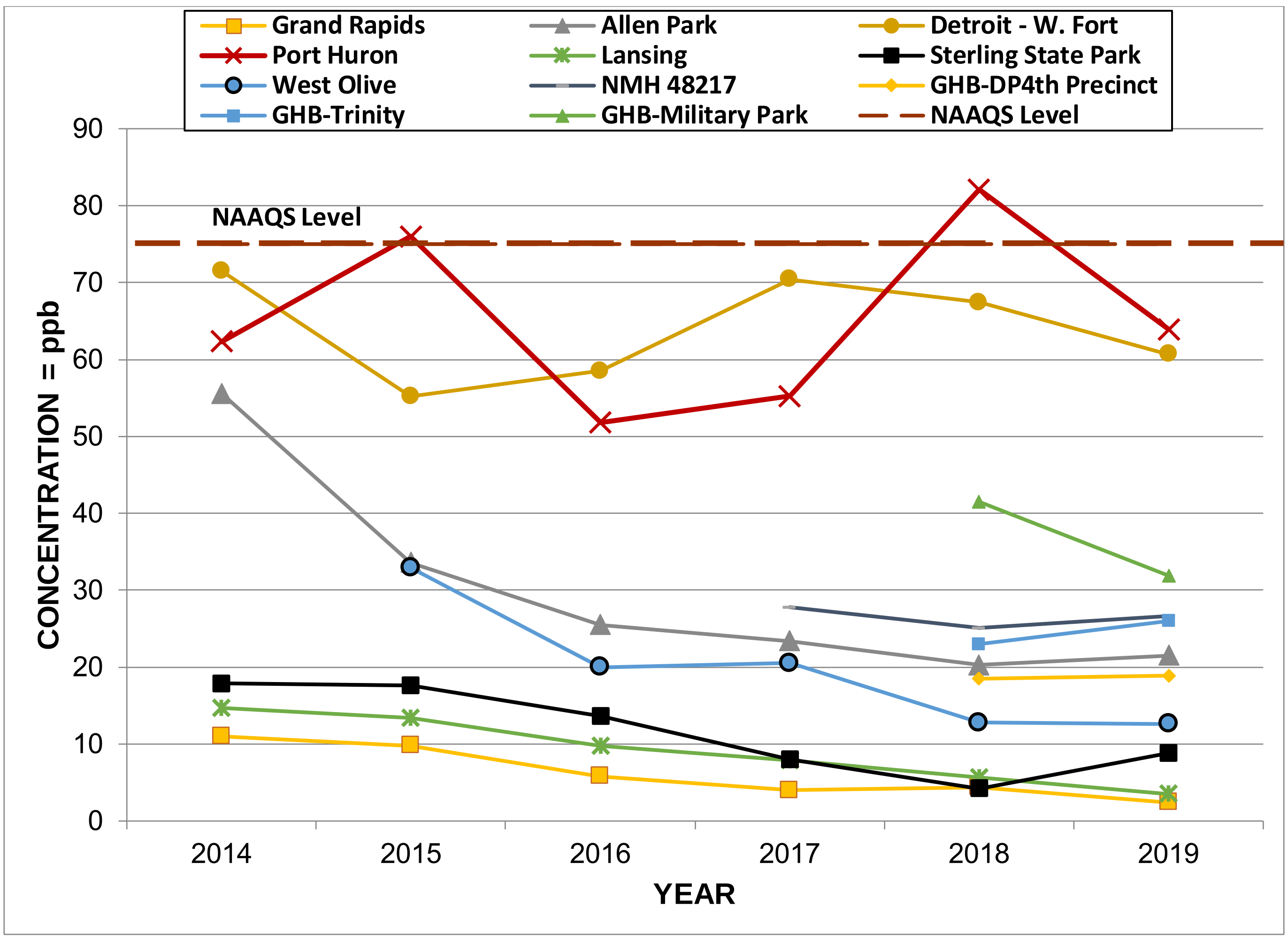
- NCore sites: Allen Park and Grand Rapids have trace SO_2 monitors that have lower detection limits than traditional SO_2 monitors.
- Source-oriented sites: Lansing, Port Huron, W. Fort St., Sterling State Park, West Olive.
- Community monitoring project: NMH 48217.
- GHB project: DP4th Precinct, Trinity, and Military Park.

Figure 5.4: Sulfur Dioxide (SO_2) Monitors in 2019

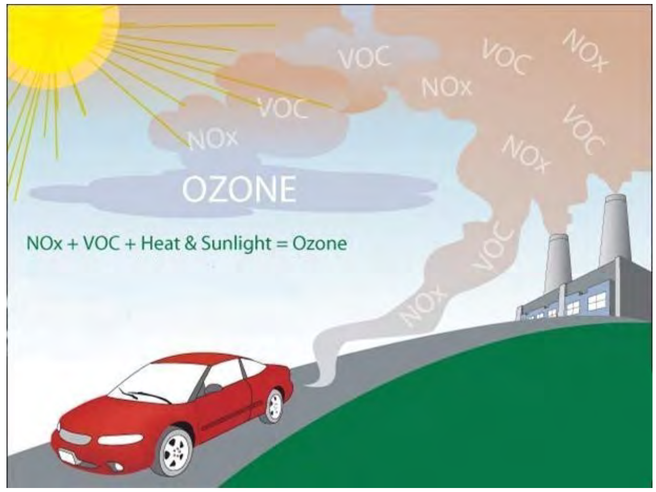
Figure 5.5 shows that all the SO_2 sites in Michigan are below the standard even though there is a nonattainment area for SO_2. The standard is a three-year average, therefore having one point above the NAAQS level line does not mean the monitor is over the standard. SO_2 pollution is extremely variable and would require a large monitoring network to designate areas as attainment. Therefore, SO_2 attainment depends on both emission modeling and monitoring data.

The NCore sites, Grand Rapids and Allen Park, monitor for trace SO_2. For trend purposes, all SO_2 data are graphed together in **Figure 5.5**.

Figure 5.5: SO_2 Level in Michigan from 2014-2019 (1-Hour 99th Percentile)



CHAPTER 6: OZONE (O_3)



Ground-level O_3 is created by reactions involving nitrogen oxides (NO_X) and volatile organic compounds (VOCs), or hydrocarbons, in the presence of sunlight as the illustration to the right depicts (image courtesy of the USEPA). These reactions usually occur during the hot summer months as ultraviolet radiation from the sun initiates a sequence of photochemical reactions. In Earth's upper atmosphere (the stratosphere), O_3 helps by absorbing much of the sun's ultraviolet radiation, but in the lower atmosphere (the troposphere), ozone is an air pollutant. O_3 is also a key ingredient of urban smog and can be transported hundreds of miles under certain meteorological conditions. Ozone levels are often higher in rural areas than in cities due to transport to regions downwind from the actual emissions of NO_X and VOCs. Shoreline monitors along Lake Michigan often measure high ozone concentrations due to transport from upwind states. The ozone NAAQS was revised by the USEPA and became effective in November 2015. It is a 3-year average of the 4th highest daily maximum 8-hour average concentration that must not exceed 0.070 ppm. The sources and effects of ozone follow.

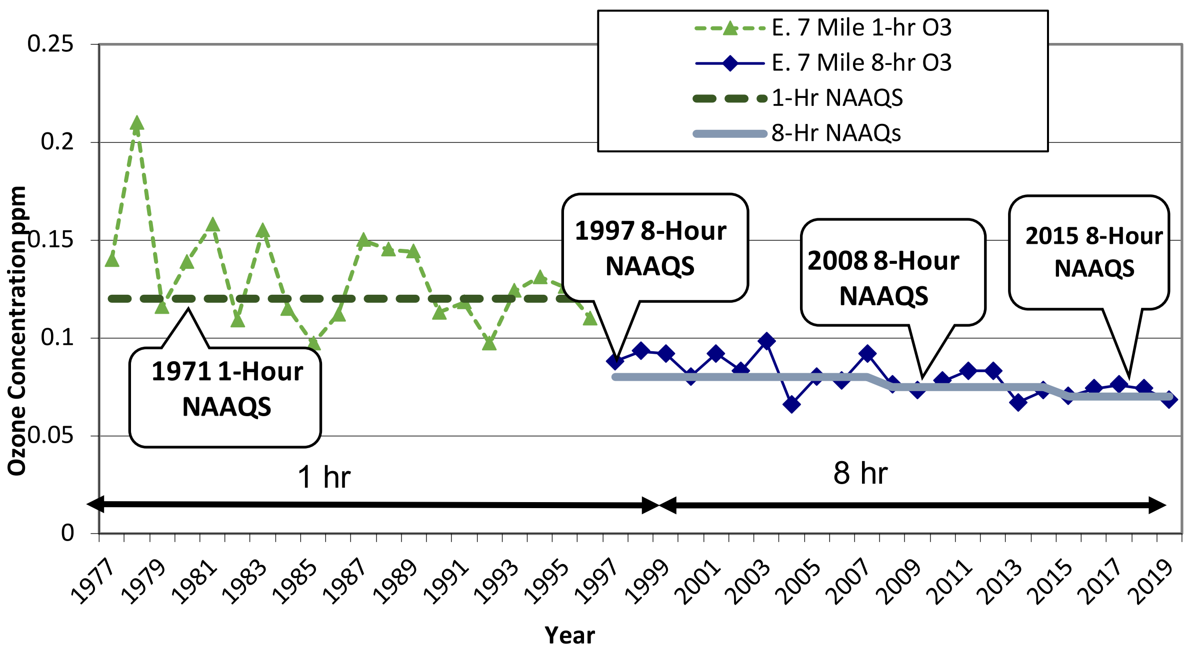
Sources: Major sources of NO_X and VOCs are engine exhaust, emissions from industrial facilities, combustion from power plants, gasoline vapors, chemical solvents, and biogenic emissions from natural sources. Ground-level O_3 can also be transported hundreds of miles under certain wind regimes. As a result, the long-range transport of air pollutants impacts the air quality of regions downwind from the actual area of formation.

Effects: Elevated O_3 exposure can irritate airways, reduce lung function, aggravate asthma and chronic lung diseases like emphysema and bronchitis, and inflame and damage the cells lining the lungs. Other effects include increased respiratory related hospital admissions with symptoms such as chest pain, shortness of breath, throat irritation, and cough. O_3 may also reduce the immune system's ability to fight off bacterial infections in the respiratory system, and long-term, repeated exposure may cause permanent lung damage. O_3 also impacts vegetation and forest ecosystems, including agricultural crop and forest yield reductions, diminished resistance to pests and pathogens, and reduced survivability of tree seedlings.

Population most at risk: Individuals most susceptible to the effects of O_3 exposure include those with a pre-existing or chronic respiratory disease, children who are active outdoors and adults who actively exercise or work outdoors.

Historical Trends: Southeast Michigan has been monitoring for ozone for over 40 years. **Figure 6.1** shows the ozone levels at the Detroit E. 7 Mile Road site. This graph shows how the standard changed from a 1-hour average of 0.120 ppm to an 8-hour average of 0.08 ppm in 1997. The standard was further lowered to 0.075 ppm in 2008 and to 0.070 ppm at the end of 2015. Ozone depends on weather conditions, so ozone concentrations are more variable than other pollutants. Ozone is also monitored primarily in warmer months. In the 2015 NAAQS, the ozone season was extended to by two months to March 1 to October 31.

Figure 6.1: Historical 1-hour and 8-hour Ozone at E. 7 Mile



Figures 6.2 and **6.3** show VOC emission sources and VOC emissions by county (courtesy of the USEPA's State and County Emission Summaries).

Figure 6.2: VOC Emissions by Source Sector

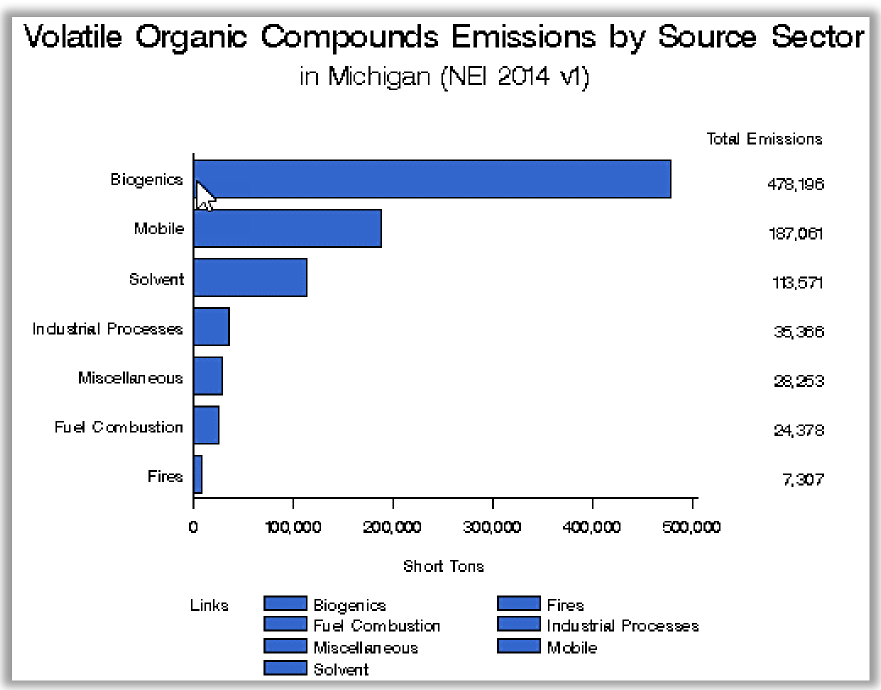


Figure 6.3: VOC Emissions in 2014

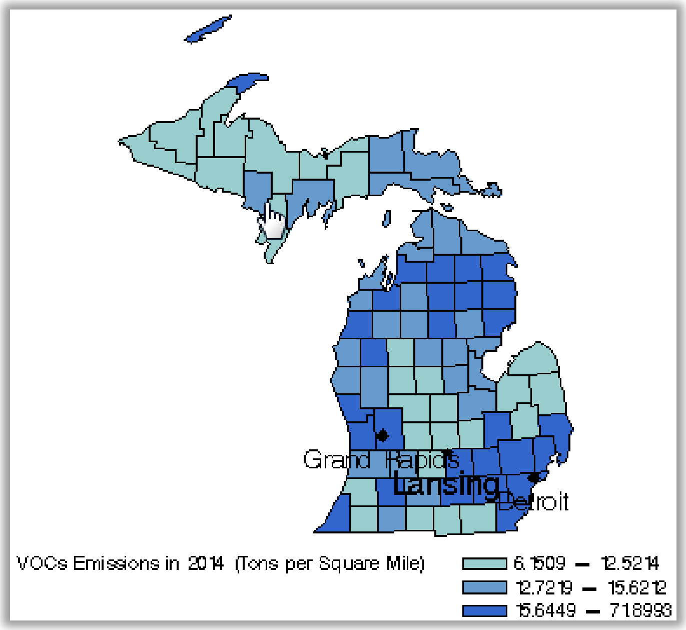


Figure 6.4 shows all O_3 air quality monitors active in Michigan at the beginning of the 2019 ozone season.

- Background site monitors: Houghton Lake, Scottville, Seney.
- Transport site monitors: Benzonia, Coloma, Harbor Beach, Holland, Muskegon, Tecumseh.
- Tribal site: Manistee
- Population-oriented monitors: all other sites.

Figure 6.4: Ozone Monitors in 2019

Table 6.1 shows the three-year averages of ozone. The USEPA uses these values (called design values) to determine attainment/nonattainment areas. In 2016, several monitors violated the 2015 standard of 0.070 ppm. The AQD recommended several counties be designated as nonattainment. The USEPA made their final designations for the 2015 standard on April 30, 2018 (effective August 3, 2018) based on 2014-2016 data. Livingston, Macomb, Monroe, Oakland, St. Clair, Washtenaw, and Wayne Counties were designated nonattainment in Southeast Michigan, and all of Berrien County, and portions of Allegan and Muskegon Counties were designated nonattainment in Western Michigan. In 2019 Berrien County was below the standard and a redesignation request was submitted to the USEPA in January of 2020.

The O_3 monitoring season in Michigan is from March 1 through October 31. During this time O_3 monitoring data is available for the public via the AQD's website (discussed in **Chapter 1**). However, year-round O_3 monitoring is conducted at the following four sites: Allen Park, Grand Rapids, Houghton Lake, and Lansing. This data helps in attainment designations, and urban air quality and population exposure assessments.

Table 6.1: 3-Year Average of the 4th Highest 8-hour Ozone Values from 2015-2017, 2016-2018, 2017-2019 (concentrations in ppm)

Areas	County	Monitor Sites	2015-2017	2016-2018	2017-2019
Detroit-Ann Arbor	Lenawee	Tecumseh	0.066	0.068	0.065
	Macomb	New Haven	**0.071**	**0.072**	0.068
		Warren	0.066	0.069	0.066
	Oakland	Oak Park	0.070	**0.073**	0.070
	St. Clair	Port Huron	**0.071**	**0.072**	**0.071**
	Washtenaw	Ypsilanti	0.067	0.069	0.066
	Wayne	Allen Park	0.066	0.068	0.066
		E. 7 Mile	**0.073**	**0.074**	**0.072**
Flint	Genesee	Flint	0.067	0.068	0.064
		Otisville	0.067	0.068	0.063
Grand Rapids	Ottawa	Jenison	0.068	0.070	0.067
	Kent	Grand Rapids	0.068	0.070	0.066
		Evans	0.067	0.068	0.064
Muskegon Co	Muskegon	Muskegon	**0.074**	**0.076**	**0.074**
Allegan Co	Allegan	Holland	**0.073**	**0.073**	**0.072**
Huron	Huron	Harbor Beach	0.067	0.068	0.064
Kalamazoo-Battle Creek	Kalamazoo	Kalamazoo	0.069	**0.071**	0.066
Lansing-East Lansing	Ingham	Lansing	0.067	0.068*	0.063
	Clinton	Rose Lake	0.066*	0.069*	0.062
Benton Harbor	Berrien	Coloma	**0.073**	**0.073**	0.069
Benzie Co	Benzie	Benzonia	0.065	0.068	0.063
Cass Co	Cass	Cassopolis	**0.072**	**0.074**	0.070
Mason Co	Mason	Scottville	0.068	0.068	0.063
Missaukee Co	Missaukee	Houghton	0.066	0.067	0.062
Manistee Co	Manistee	Manistee	0.067	0.066	0.064
Schoolcraft Co	Schoolcraft	Seney	0.067	0.064	0.059

Numbers in bold indicate 3-year averages over the 2015 ozone standard of 0.070 ppm.

*The three-year average is using data averaged from sites that were moved.

Tables 6.2 and 6.3 highlight the number of days when two or more O_3 monitors exceeded 0.070 ppm. It also specifies in which month they occurred and the temperature range.

Table 6.2: 2019 West Michigan Ozone Season

Daily High Temperature Range			2019 WEST MICHIGAN OZONE SEASON															
			March		April		May		June		July		August		September		October	
					Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days
	>=	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
90	<=	94	0	0	0	0	0	0	0	0	7	2	0	0	0	0	0	0
85	<=	89	0	0	0	0	0	0	4	0	9	0	10	0	3	0	0	0
80	<=	84	0	0	0	0	0	0	7	0	12	0	11	0	7	0	0	0
75	<=	79	0	0	1	0	7	0	8	0	3	0	5	0	3	0	1	0
70	<=	74	0	0	3	0	6	0	6	0	0	0	5	0	9	0	3	0
65	<=	69	0	0	5	0	6	0	3	0	0	0	0	0	7	0	6	0
60	<=	64	1	0	5	0	3	0	2	0	0	0	0	0	1	0	3	0
55	<=	59	3	0	3	0	7	0	0	0	0	0	0	0	0	0	6	0
50	<=	54	2	0	4	0	1	0	0	0	0	0	0	0	0	0	8	0
49	<=		25	0	9	0	1	0	0	0	0	0	0	0	0	0	4	0
Totals			**31**	**0**	**30**	**0**	**31**	**0**	**30**	**0**	**31**	**2**	**31**	**0**	**30**	**0**	**31**	**0**

Days: Number of days during month when the daily high temperature falls within the specified temperature range.
O_3 Days: Number of days, during specified temperature range, when two or more area monitors exceeded 70 ppb.

For West Michigan, there were two O_3 exceedance days in July when ozone exceeded 0.070 ppm at two or more ozone monitors. The temperatures for those days ranged between 90°F and 94°F.

Table 6.3: 2019 Southeast Michigan Ozone Season

Daily High Temperature Range			2019 SOUTHEAST MICHIGAN OZONE SEASON															
			March		April		May		June		July		August		September		October	
					Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days
	>=	95	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
90	<=	94	0	0	0	0	0	0	2	0	8	1	0	0	0	0	0	0
85	<=	89	0	0	0	0	1	0	3	1	10	0	9	0	5	0	1	0
80	<=	84	0	0	0	0	3	0	3	0	10	0	12	0	2	0	0	0
75	<=	79	0	0	0	0	2	0	12	0	2	0	8	0	11	0	0	0
70	<=	74	0	0	3	0	6	0	6	0	0	0	2	0	8	0	6	0
65	<=	69	1	0	5	0	9	0	2	0	0	0	0	0	3	0	4	0
60	<=	64	1	0	3	0	4	0	2	0	0	0	0	0	1	0	9	0
55	<=	59	1	0	6	0	1	0	0	0	0	0	0	0	0	0	6	0
50	<=	54	3	0	4	0	5	0	0	0	0	0	0	0	0	0	3	0
49	<=		25	0	9	0	0	0	0	0	0	0	0	0	0	0	2	0
Totals			**31**	**0**	**30**	**0**	**31**	**0**	**30**	**1**	**31**	**1**	**31**	**0**	**30**	**0**	**31**	**0**

Days: Number of days during month when the daily high temperature falls within the specified temperature range.
O_3 Days: Number of days, during specified temperature range, when two or more area monitors exceeded 70 ppb.

For Southeast Michigan, there was one day each in June and July when ozone exceeded 0.070 ppm at two or more ozone monitors. The temperature for those days ranged between 85°F and 94°F.

Table 6.4 gives a breakdown of the O_3 days and the specific monitors that went over the standard in western, central/upper, and eastern Michigan in 2019.

Table 6.4: Monitors with 8-Hour Exceedances (>0.070 ppm) of the Ozone Standard

Date	Western Michigan	Central / Upper Michigan	Eastern Michigan	Total
6/27/2019	Manistee		E. Seven Mile, Oak Park	3
7/1/2019			E. 7 Mile	1
7/2/2019	Coloma, Holland			2
7/5/2019	Holland			1
7/10/2019	Coloma, Holland, Muskegon		E. 7 Mile, New Haven, Port Huron	6
7/15/2019			Oak Park	1
7/27/2019			Port Huron	1
7/28/2019	Holland			1
8/12/2019			Port Huron	1
			TOTAL	**17**

On July 10, 2019, there were 6 monitors and on June 27, 2019, there were 3 monitor readings that exceeded the level of the standard. The site with the most exceedances in the western region of Michigan was Holland with four. The central/upper Michigan sites had no exceedances. Port Huron and E. 7 Mile had 3 exceedances each in eastern Michigan

Figure 6.5 shows the 4th highest 8-hour O_3 values for Southeast Michigan monitoring sites from 2014-2019. Detroit-E. 7 Mile and Port Huron site violated the 3-year standard.

Figure 6.6 shows the 4th highest 8-hour O_3 values for Grand Rapids-Muskegon-Holland CSA. Muskegon and Holland violated the 3-year standard.

Figure 6.7 shows 4th highest 8-hour O_3 values for mid-Michigan. Coloma and Kalamazoo violated the 3-year standard.

Figure 6.8 shows 4th highest 8-hour O_3 values for Northern Lower and Upper Peninsula. No sites violated the 3-year standard.

Figure 6.5: O_3 Levels in Detroit-Warren-Flint CSA from 2014-2019 - (4th Highest 8-Hour O_3 Values).

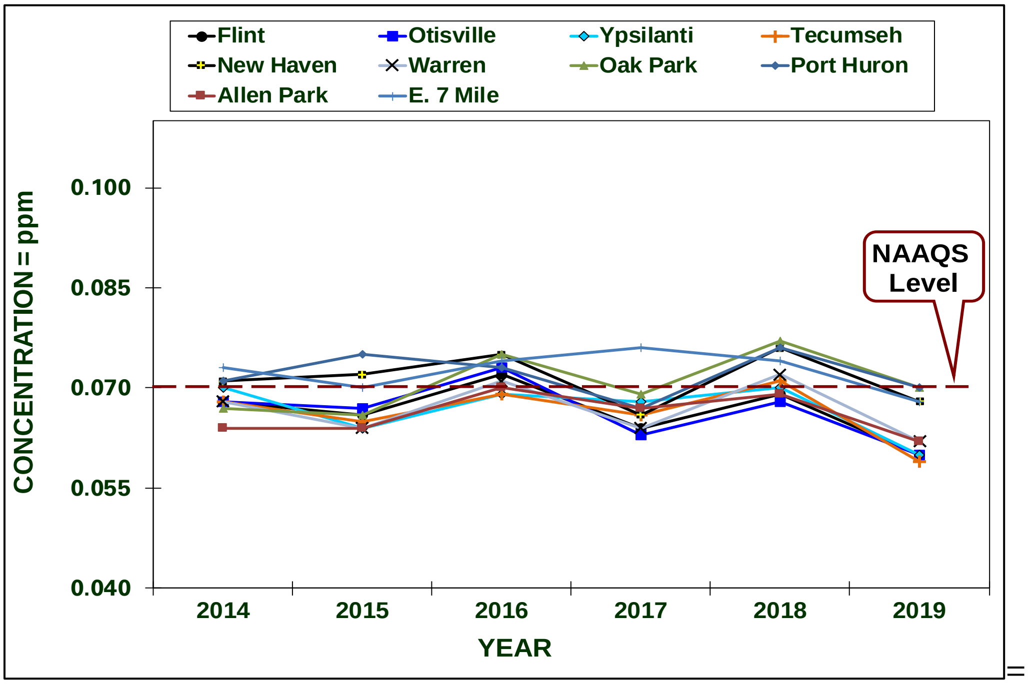


Figure 6.6: O_3 Levels in the Grand Rapids-Muskegon-Holland CSA from 2014-2019 (4th Highest 8-Hour O_3 Values)

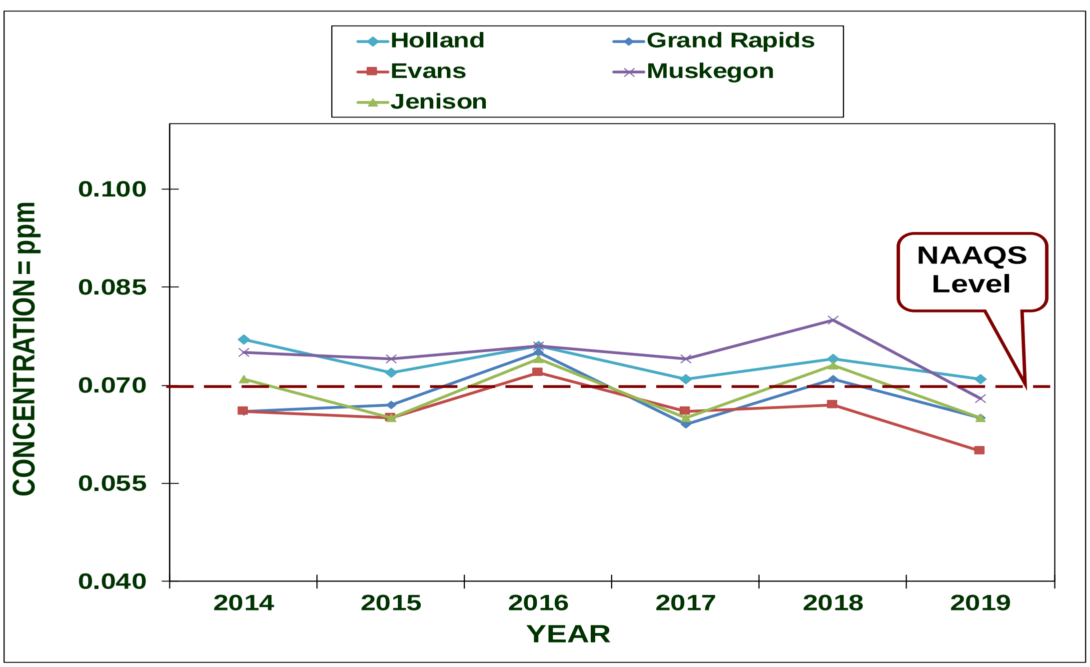


Figure 6.7: O_3 Levels in the Kalamazoo-Portage MSA, Lansing-E. Lansing-Owosso CSA, Niles-Benton Harbor MSA, & South Bend-Mishawaka (IN-MI) MSAs from 2014-2019 (4th Highest 8-Hour O_3 Values)

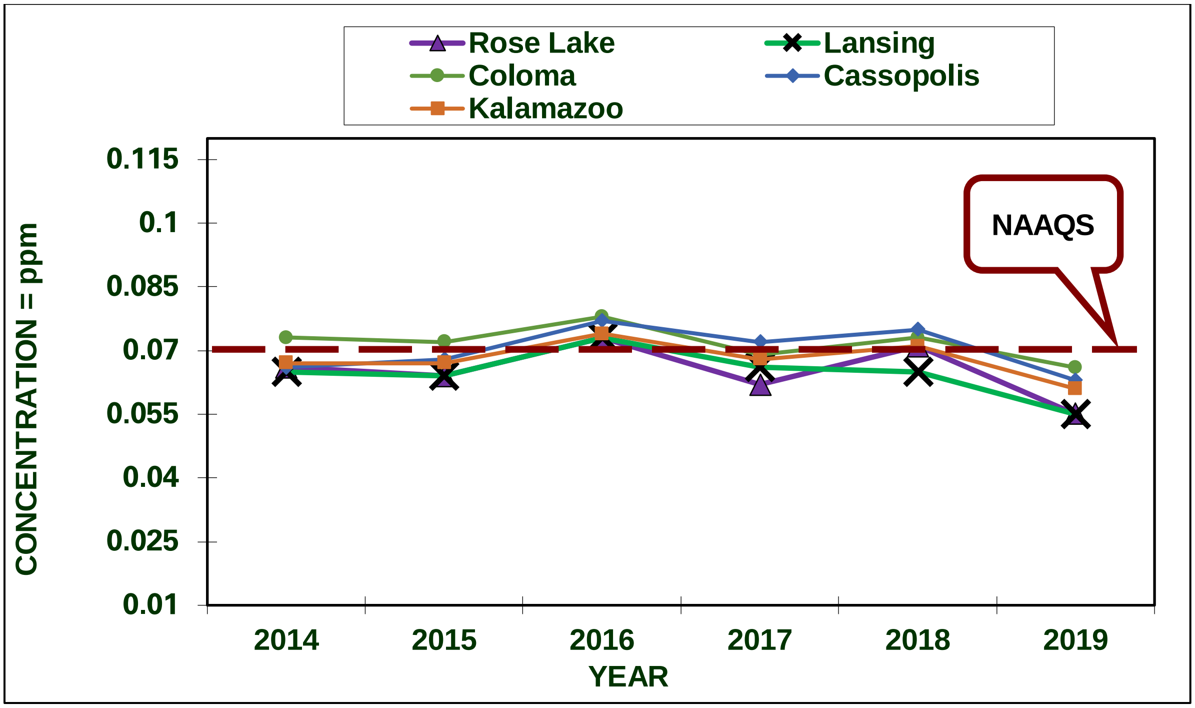
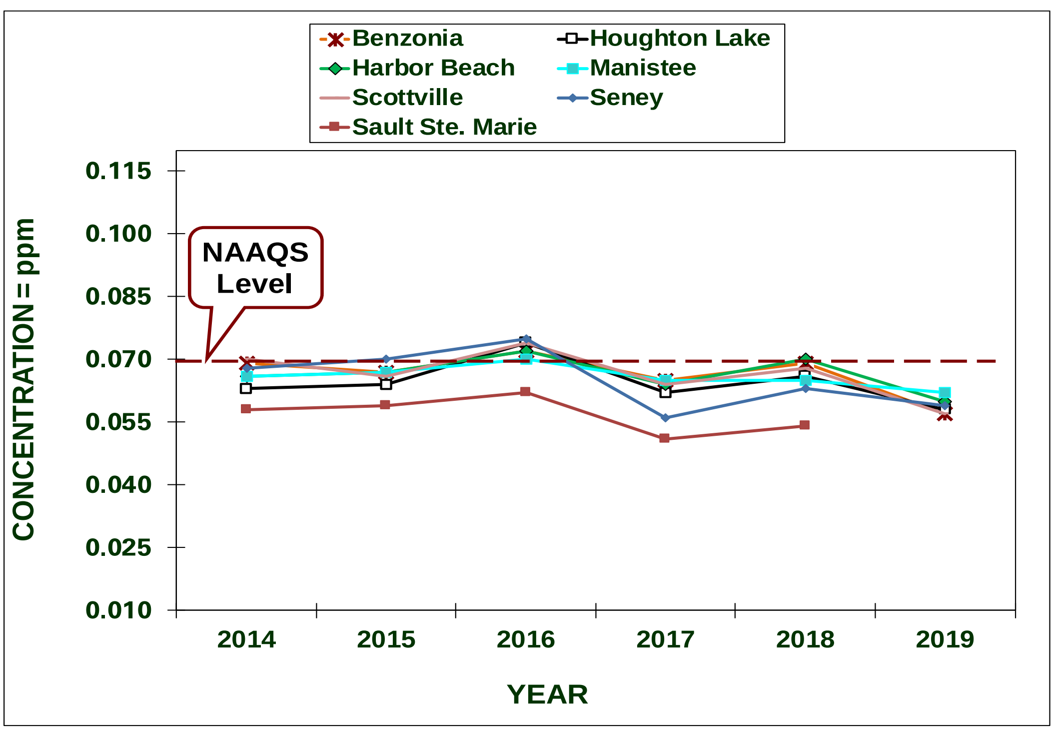
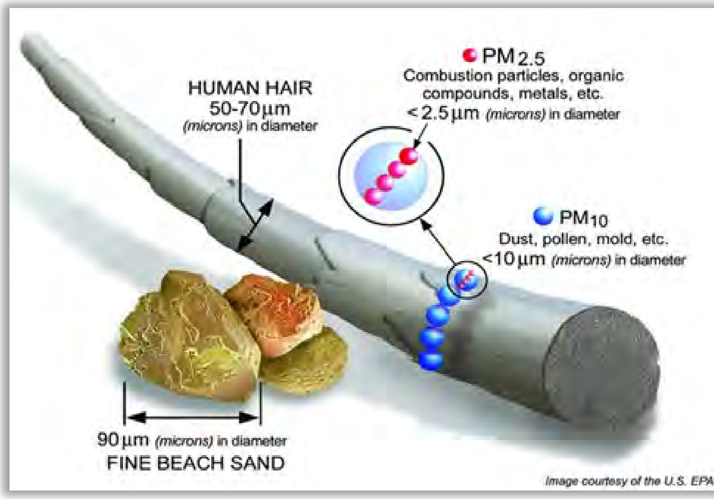


Figure 6.8: O_3 Levels in MI's Northern Lower and Upper Peninsula Areas from 2014-2019 (4th Highest 8-Hour O_3 Values)



CHAPTER 7: PARTICULATE MATTER (PM_{10}, $PM_{10-2.5}$, $PM_{2.5}$, $PM_{2.5}$ CHEMICAL SPECIATION AND TSP)

Particulate matter (PM) is a general term used for a mixture of solid particles and liquid droplets (aerosols) found in the air. These are further categorized according to size; larger particles with diameters of less than 50 micrometers (µm) are classified as total suspended particulates (TSP). PM_{10} consists of "coarse particles" less than 10 µm in diameter (about one-seventh the diameter of a human hair) and $PM_{2.5}$ are much smaller "fine particles" equal to or less than 2.5 µm in diameter. PM_{10} has a 24-hour average standard of 150 µg/m^3 not to be exceeded more than once per year over 3 years. $PM_{2.5}$ has an annual average standard of 12 µg/m^3, and a 98th percentile 24-hour concentration of 35 µg/m^3 averaged over 3 years. The sources and effects of PM are as follows:



Sources: PM can be emitted directly (primary) or may form in the atmosphere (secondary). Most man-made particulate emissions are classified as TSP. PM_{10} consists of primary particles that can originate from power plants, various manufacturing processes, wood stoves and fireplaces, agriculture and forestry practices, fugitive dust sources (road dust and windblown soil), and forest fires. $PM_{2.5}$ can come directly from primary particle emissions or through secondary reactions that include VOCs, SO_2, and NO_X emissions originating from power plants, motor vehicles (especially diesel trucks and buses), industrial facilities, and other types of combustion sources.

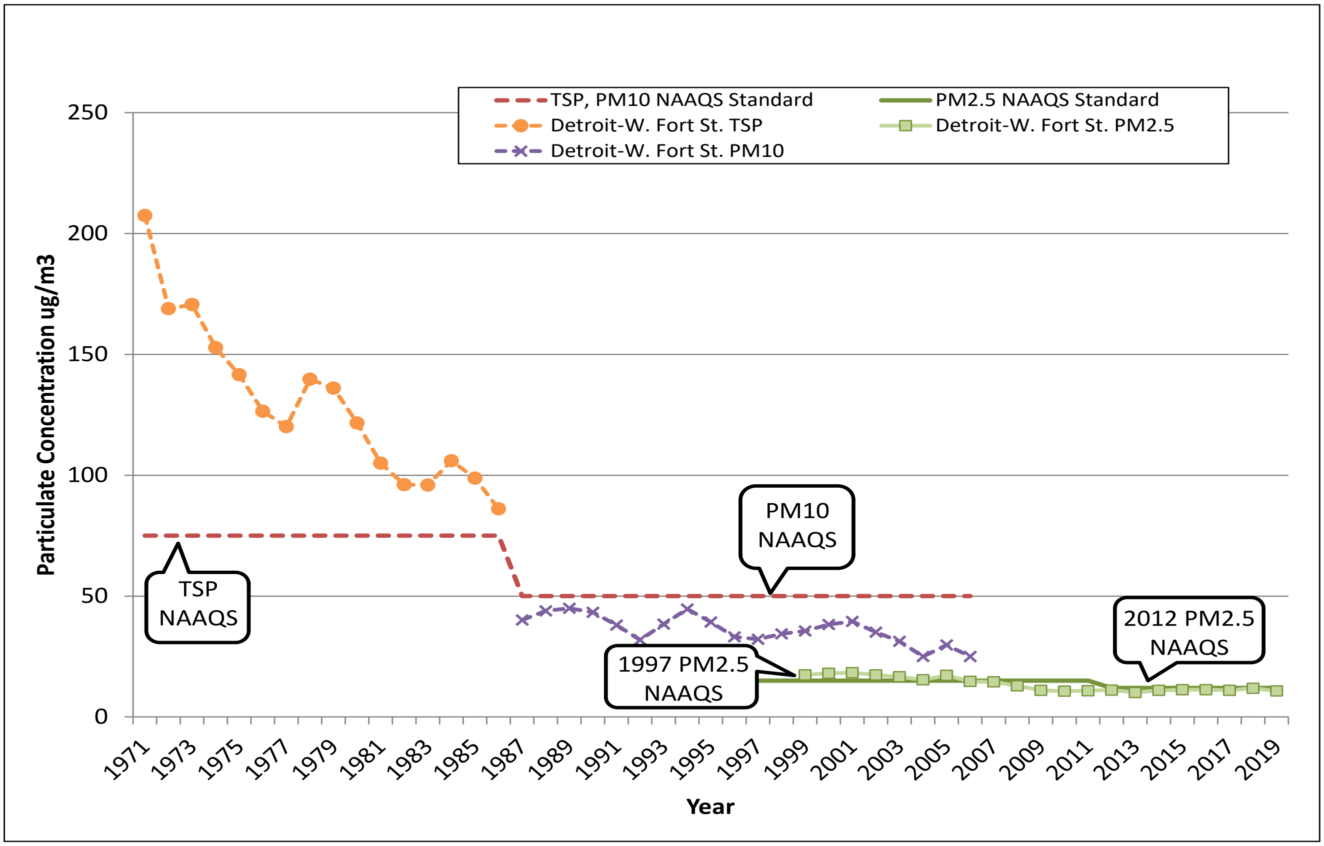
Effects: Exposure to PM can aggravate existing cardiovascular ailments and even cause death in susceptible populations. PM may affect breathing and the cellular defenses of the lungs and has been linked with heart and lung disease. Smaller particles (PM_{10} or smaller) pose the greatest problems, because they can penetrate deep in the lungs and possibly into the bloodstream. PM is the major cause of reduced visibility in many parts of the United States. $PM_{2.5}$ is considered a primary visibility-reducing component of urban and regional haze. Airborne particles impact vegetation ecosystems and damage paints, building materials and surfaces. Deposition of acid aerosols and salts increases corrosion of metals and impacts plant tissue.

Population most at risk: People with heart or lung disease, the elderly, and children are at highest risk from exposure to PM.

Historical Trends: Southeast Michigan has been monitoring for particulate for over 40 years. **Figure 7.1** shows the trends for particulate matter. In 1971, the USEPA promulgated an annual and 24-hour particulate standard based on total suspended particulates (TSP). In 1987, the USEPA changed the standard to PM_{10}. Health studies indicated that particles smaller than 10 microns affect respiration. In 1997, the USEPA added additional NAAQS for a smaller particle fraction size, $PM_{2.5}$, which can get deeper into the lungs and possibly into the blood stream. In 2006, the USEPA revoked the PM_{10} annual standard but kept the PM_{10} 24-hour standard. The $PM_{2.5}$ 24-hour standard was also reduced from 65 µg/m^3 to 35 µg/m^3. In 2012, the USEPA reduced the annual standard from 15 µg/m^3 to 12 µg/m^3.

Particulate trends show that particulate concentrations have decreased, and the state is in compliance for all particulate NAAQS; however, Michigan has had past nonattainment issues in Southeast Michigan for TSP, PM_{10} and $PM_{2.5}$.

Figure 7.1: Historical Annual Particulate Matter at W. Fort St. (SWHS)



PM_{10}

Figures 7.2 and **7.3** show PM_{10} emission sources and PM_{10} emissions by county (courtesy of the USEPA's State and County Emission Summaries).

Figure 7.2: PM_{10} Emissions by Source Sector

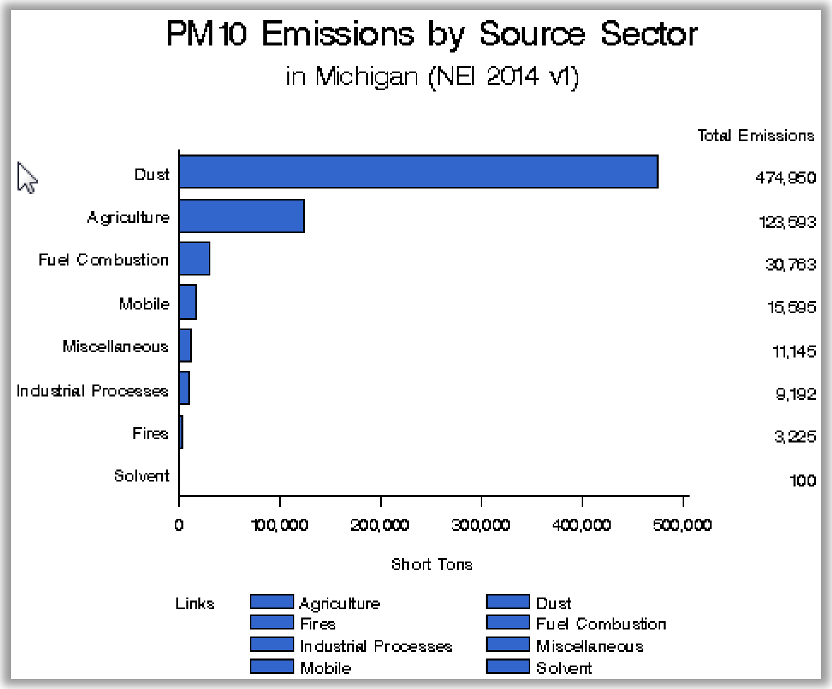
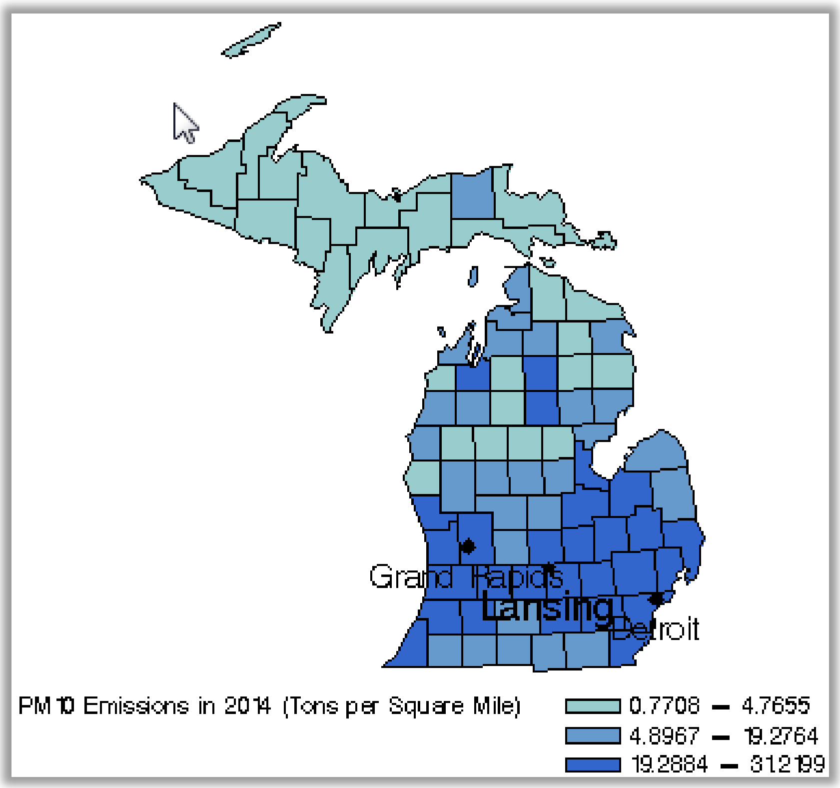


Figure 7.3: PM_{10} Emissions in 2014



Since October 1996, all areas in Michigan have been in attainment with the PM_{10} NAAQS. Due to the recent focus upon $PM_{2.5}$ and because of the relatively low concentrations of PM_{10} measured in recent years, Michigan's PM_{10} network has been reduced to a minimum level. Table 1-3 identifies the locations of PM_{10} monitoring stations that were operating in Michigan during 2016. These monitors are located mostly in the state's largest populated urban areas: three in the Detroit area and two in Grand Rapids. To better characterize the nature of particulate matter in Michigan, many of the existing PM_{10} monitors are co-located with $PM_{2.5}$ monitors in population-oriented areas.

Figure 7.4 shows the location of each PM_{10} monitor. All PM_{10} monitors are population-oriented monitors. A second PM_{10} monitor was added to the Grand Rapids area in Jenison (**Figure 7.5**) based on the USEPA's population requirements.

Figure 7.4: PM_{10} Monitors in 2019

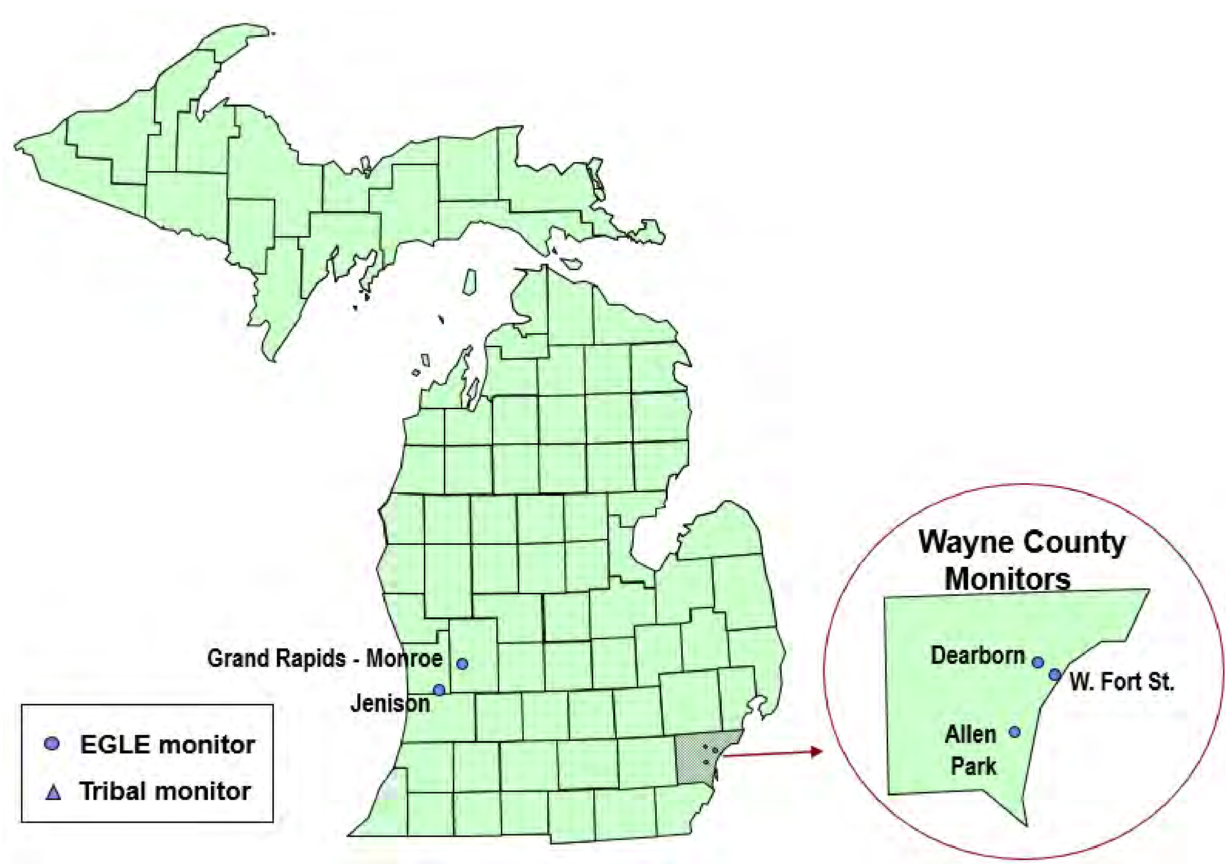
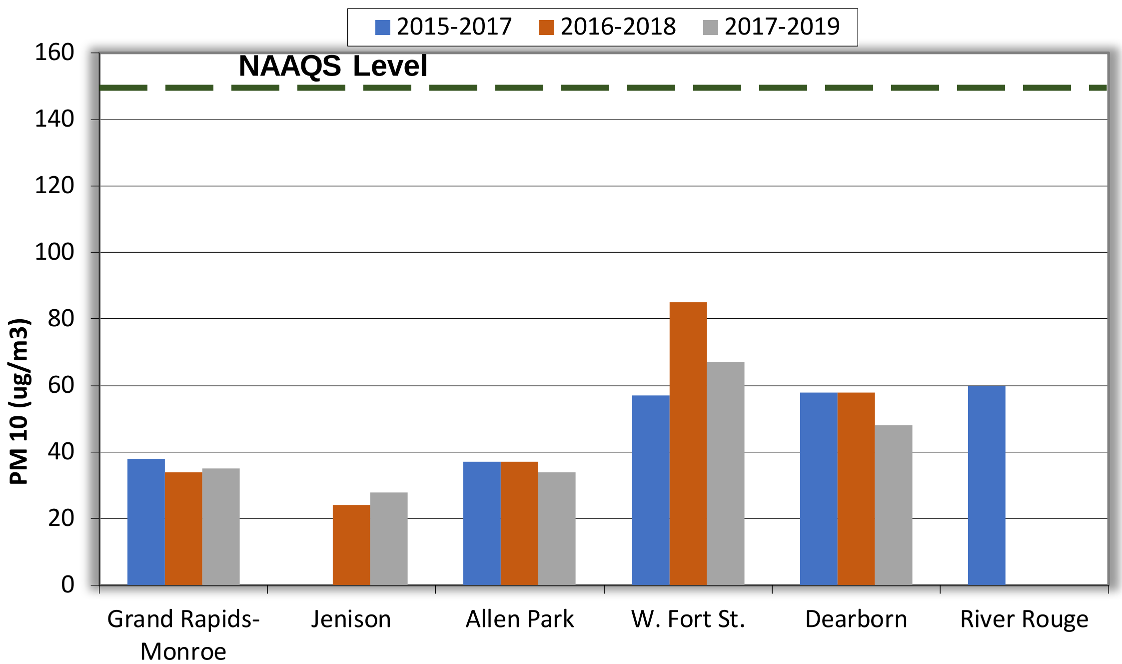


Figure 7.6 shows the PM_{10} levels in Michigan compared to the 24-hour average NAAQS of 150 µg/m^3. This standard must not be exceeded on average more than once per year over a 3-year period. The design value is the 4th highest value over a 3-year period. The PM_{10} levels at all sites in Michigan are well below the national standard.

Figure 7.6: 24-Hour PM_{10} Design Value

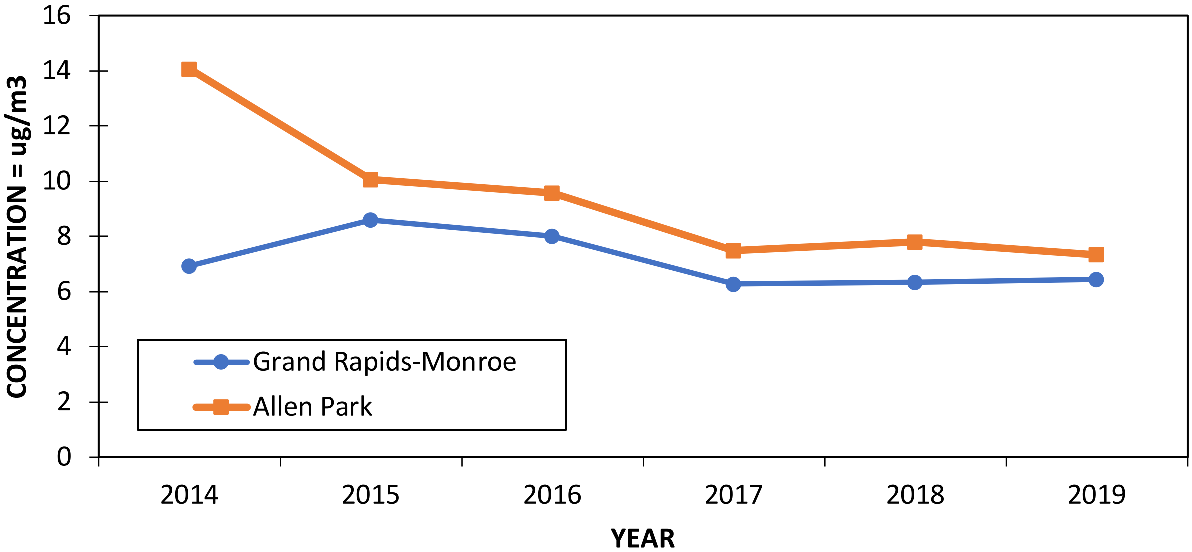


$PM_{10-2.5}$

The 2006 amended air monitoring regulations specified that measurements of PM course ($PM_{10-2.5}$) needed to be added to the NCore sites.[5] EGLE began PM course monitoring at Allen Park and Grand Rapids-Monroe Street in 2010. **Figure 7.7** shows the $PM_{10-2.5}$ levels in Michigan.

[5] Current information can be found at www3.epa.gov/ttn/amtic/ncoreguidance.html.

Figure 7.7: PM Coarse Levels in Michigan from 2014-2019 (Annual Arithmetic Mean)



$PM_{2.5}$

In December 2012, the USEPA revised the annual primary standard to 12 µg/m³ while the annual secondary standard remained at 15 µg/m³. The primary and secondary 24-hour standard remained at 35 µg/m³. In December 2014, the USEPA determined that no area in Michigan violated the 2012 standard and the state was classified as unclassifiable/attainment.

Figures 7.8 and **7.9** show $PM_{2.5}$ emission sources and $PM_{2.5}$ emissions by county (from the USEPA's State and County Emission Summaries).

Figure 7.8: $PM_{2.5}$ Emissions by Source Sector

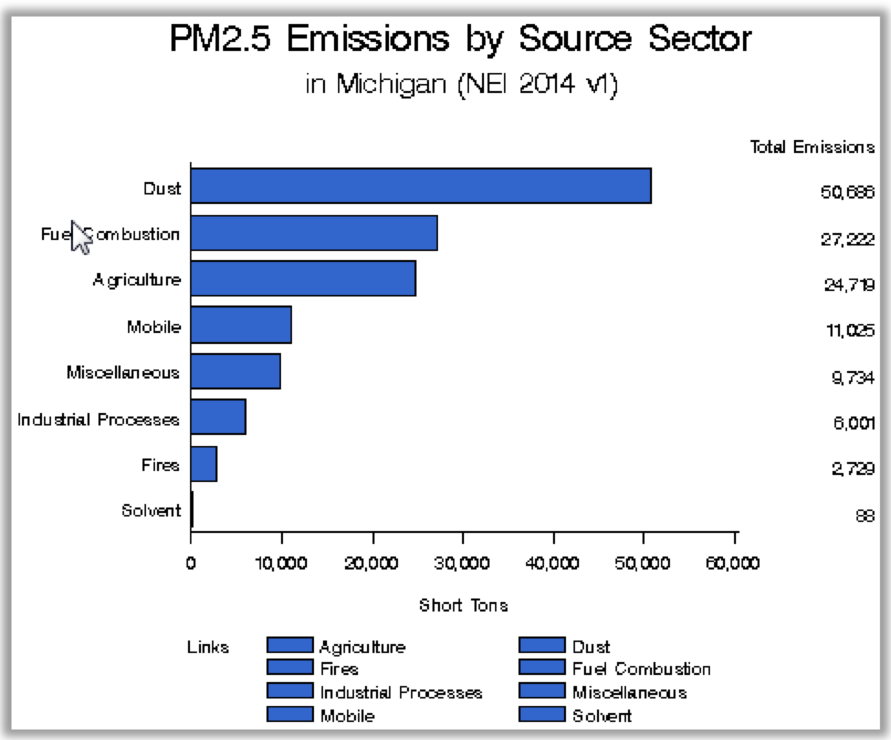
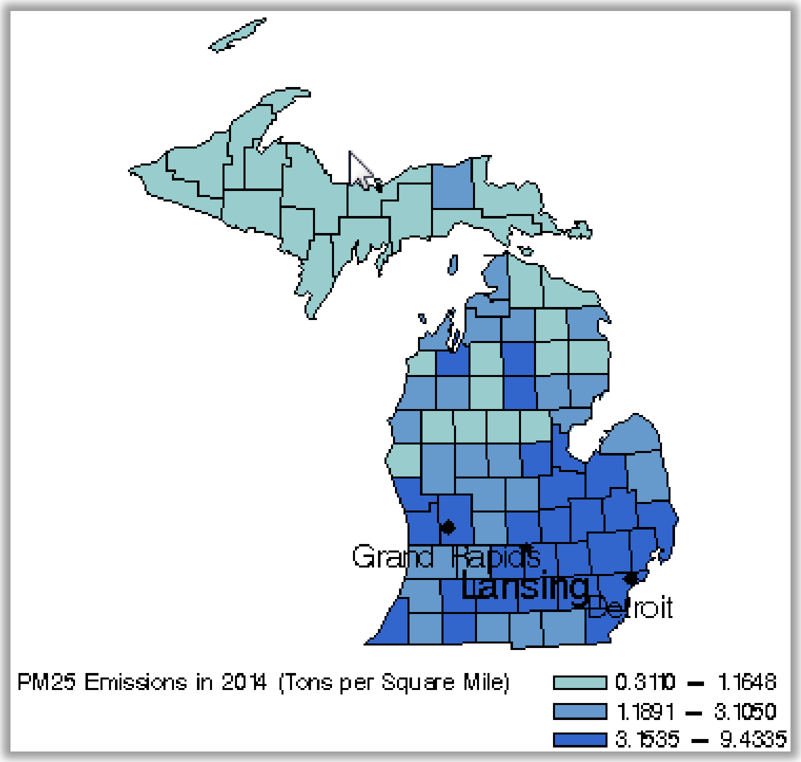


Figure 7.9: $PM_{2.5}$ Emissions in 2014



Fine particulate matter ($PM_{2.5}$) is measured using three techniques: a filter-based Federal Reference Method (FRM), Continuous Methods, and Chemical Speciation Methods. These methods are described in more detail in Appendix A.

Figure 7.10 shows the location of each $PM_{2.5}$ monitor.

$PM_{2.5}$ FRM Monitoring Network: $PM_{2.5}$ FRM filter-based monitors are deployed to characterize background or regional $PM_{2.5}$ transport collectively from upwind sources as well as population-oriented sites. Several changes occurred in the FRM network in 2019.

- Loss of site access shut down: Livonia Near-road and Livonia was shut down July 2019, but a suitable replacement site for the near-road site has not been found yet.
- Monitors shut down: Livonia, Linwood, Wyandotte, and Eliza Howell-downwind were shut down to reduce costs and workload. Eliza Howell-downwind also is not required for near-road monitoring. Sault Ste. Marie was shutdown February 2019 due to funding.
- Collocation sites: Five $PM_{2.5}$ FRM monitoring sites are co-located with PM_{10} monitors to allow for $PM_{2.5}$ and PM_{10} comparisons.[6] Co-located PM_{10} and $PM_{2.5}$ sites include Grand Rapids-Monroe, Dearborn, Allen Park, Detroit's W. Fort Street (SWHS), and newly added site, Jenison.
- Change in sampling frequency: The sampling frequency at Allen Park was reduced from daily to 1 in 3-day sampling.
- Switched FRMs to BAMs: Houghton Lake and Tecumseh were switched to BAMs since the USEPA is reducing the funding for FRMs.

Figure 7.10: $PM_{2.5}$ Monitors in 2019

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6 Requirements for $PM_{2.5}$ FRM sites are obtained from the Revised Requirements for Designation of Reference and Equivalent Methods for $PM_{2.5}$ and Ambient Air Quality Surveillance for PM [62 FR 38763]; Guidance for Using Continuous Monitors in $PM_{2.5}$ Monitoring Networks [EPA-454/R-98-012, May 1998]; and Appendix N to Part 50 - Interpretation of the National Ambient Air Quality Standards for PM [40 CFR Part 50, July 1, 1998].

Continuous $PM_{2.5}$ Network: Short-term measurements of $PM_{2.5}$ or PM_{10} are updated on an hourly basis using TEOM or BAM instruments. At least one continuous monitor is required at the NCore $PM_{2.5}$ monitoring site in a metropolitan area with a population greater than one million. Both Detroit (Allen Park) and Grand Rapids (Monroe) meet this requirement.[7] Under the revised 2006 air monitoring regulations, 50 percent of the FRM monitoring sites are now required to have a continuous $PM_{2.5}$ monitor. For Michigan, there are 22 FRM monitoring sites, 12 of which also had TEOMs or BAMs.

- BAMs replaced TEOMS: Tecumseh and Houghton Lake stopped running the FRMs on January 1, 2019 and the BAMs will be used for NAAQS comparison. Seney was formerly running a TEOM and by changing it to a BAM, it will be used for NAAQS comparison in the Upper Peninsula of Michigan starting January 1, 2019. The Sault Ste. Marie tribal monitor site, also in the Upper Peninsula was running a BAM until February 2019 when funding was discontinued at that site. A BAM replaced the TEOM at Ypsilanti but continues to be collocated with an FRM.
- GHB project: DP4th Precinct, Trinity, and Military Park; also, the $PM_{2.5}$ BAM monitor was added to Detroit-W. Fort St. as a special project for the Gordie Howe International Bridge construction.

Speciation Monitors: Speciation monitors consist of filter-based, 24-hour monitors and continuous speciation aethalometers. Continuous monitors are used to determine diurnal changes in $PM_{2.5}$ composition.

- 24-hour speciation monitors: Allen Park and Grand Rapids (NCore sites), Dearborn (NATTS site), and Detroit-W. Fort St. The Tecumseh speciation monitor was shut down in 2019. These monitors are placed in population-oriented stations in both urban and rural locations. $PM_{2.5}$ chemical speciation samples are collected over a 24-hour period and analyzed to determine various components of $PM_{2.5}$. The primary objectives of the chemical speciation monitoring sites are to provide data that will be used to determine sources of poor air quality and to support the development of attainment strategies. Historical speciation data for Michigan indicates that $PM_{2.5}$ is made up of 30 percent nitrate compounds, 30 percent sulfate compounds, 30 percent organic carbon,[8] and 10 percent unidentified or trace elements.
- Aethalometers: Allen Park, Dearborn, and the GHB project (DP4th Precinct, Trinity, Military Park, and Detroit-W. Fort St. started in 2018). These continuous monitors measure black carbon, a combustion by-product typical of transportation sources.

Figure 1.3 in Chapter 1 shows all of Michigan's $PM_{2.5}$ FRM monitoring stations operating in 2019 and denotes which sites have TEOM, BAM, Speciation, or Aethalometer monitors in operation.

[7] Under the Guidance for Using Continuous Monitors in $PM_{2.5}$ Monitoring Networks [EPA-454/R-98-012, May 1998].
[8] To better understand the chemical composition of the organic carbon fraction, several studies have been conducted in Southeast Michigan to further investigate organic carbon. Information can be found in the Michigan 2012 Ambient Air Monitoring Network Review, available at http://www.michigan.gov/documents/deq/deq-aqd-aqe-2012-Air-Mon-Network-Review_357137_7.pdf

Table 7.1 provides the design value, the 3-year average of the annual mean $PM_{2.5}$ concentrations for 2017-2019. Michigan's levels are below the 12 µg/m^3 primary standard.[9]

Stations labeled #2 provide a precision estimate of the overall measurement and operate on a one-in-six sampling schedule. All other monitors are sampled on a one-in-three-day schedule. Allen Park samples daily but was switched to a one-in-three-day schedule in July 2019.

Table 7.1: 3-Year Average of the Annual Mean $PM_{2.5}$ Concentrations

Areas	County	Monitoring Sites	2017	2018	2019	2017-2019 Mean
Detroit-Ann Arbor	Lenawee	Tecumseh	7.34	7.96	8.50	8.1
	Livingston					
	Macomb	New Haven	7.41	7.82	7.30	7.5
	Oakland	Oak Park	8.11	8.27	7.74	8.0
	St. Clair	Port Huron	8.01	8.09	7.64	7.9
	Washtenaw	Ypsilanti #1	7.93	8.35	8.33	8.2
		Ypsilanti #2	8.32	8.81	7.57	8.2
	Wayne	Allen Park	8.47	9.14	8.69	8.8
		Detroit-Linwood	8.99	8.86		8.9
		Detroit-E. 7 Mile	7.88	8.40	7.61	8.0
		Detroit-W. Fort St.	11.01	11.89	10.76	11.2
		Detroit-W. Lafayette	7.93*	8.87*		8.4
		Wyandotte	7.18	8.02		7.6
		Dearborn #1	10.57	10.80	9.90	10.4
		Dearborn #2	10.82	11.06	9.08	10.3
		Livonia	7.98	7.45*		7.9
		Livonia-Roadway	7.60	9.10	8.36*	8.3
Flint	Genesee	Flint	7.10	7.33	6.81	7.3
	Lapeer					
Grand Rapids	Ottawa	Jenison		8.32*	8.30	8.3
	Kent	Grand Rapids-Wealthy	9.15			9.0
		Grand Rapids #1	8.12	8.45	8.20	8.2
		Grand Rapids #2	8.31	8.93	7.2*	8.2
Allegan Co	Allegan	Holland	7.49	7.61	7.15	7.4
Monroe Co	Monroe	Luna Pier				
		Sterling State Park	7.71			7.7
Kalamazoo-Battle Creek	Calhoun					
	Kalamazoo	Kalamazoo #1	8.03	8.47	7.35*	7.9
		Kalamazoo #2	8.36	8.68	6.83	8.0
	Van Buren					
Lansing-East Lansing	Ingham	Lansing	7.23	7.73**	7.27*	7.5*
	Clinton					
	Eaton					
Benton Harbor	Berrien	Coloma	7.99			7.7
Bay Co	Bay	Bay City	6.75	7.15	6.78	6.9
Missaukee Co	Missaukee	Houghton Lake	4.81	5.42	5.8*	5.4
Manistee Co	Manistee	Manistee	5.84	6.13	4.93*	5.6
Schoolcraft Co	Schoolcraft	Seney		4.1*	4.30	4.2
Chippewa Co	Chippewa	Sault Ste. Marie #1	6.10*			6.1*

*Indicates the site does not have a complete year of data.

**Indicates site was moved during the year and concentrations were averaged together for both locations

[9] For comparison to the standard, the average annual means is rounded to the nearest 0.1 µg/m^3.

Table 7.2 provides the 24-hour 98th percentile $PM_{2.5}$ concentrations for 2017-2019 showing Michigan's levels are below the 35 $\mu g/m^3$ standard (3-year average).[10]

Table 7.2: 24-Hour 98th Percentile $PM_{2.5}$ Values Averaged over 3 Years

Areas	County	Monitoring Sites	2017	2018	2019	2017-2019 Mean
Detroit-Ann Arbor	Lenawee	Tecumseh	17.5	23.4	22.1	21
	Livingston					
	Macomb	New Haven	17.0	18.9	18.7	18
	Oakland	Oak Park	20.1	20.1	18.2	19
	St. Clair	Port Huron	19.2	19.6	20.3	20
	Washtenaw	Ypsilanti #1	18.8	21.3	21.2	20
		Ypsilanti #2	19.0	19.1	22.9	20
	Wayne	Allen Park	21.8	22.8	20.0	22
		Detroit-Linwood	25.0	18.6		22
		Detroit-E. 7 Mile	16.6	21.5	19.6	19
		Detroit-W. Fort St.	30.0	28.1	22.5	27
		Detroit-W. Lafayette	19.5	26.9		23
		Wyandotte	19.3	20.4		20
		Dearborn #1	24.5	26.1	24.0	25
		Dearborn #2	23.5	26.6	24.2	25
		Livonia	19.1	18.1		19
		Livonia-Roadway	19.0	29.0	22.8*	24
Flint	Genesee	Flint	16.8	16.9	17.5	17
	Lapeer					
Grand Rapids	Ottawa	Jenison		22.3	24.4	23
	Kent	Grand Rapids-Wealthy	26.2			24
		Grand Rapids #1	22.6	18.9	23.2	22
		Grand Rapids #2	22.8	26.5	18.9	23
Allegan Co	Allegan	Holland	24.6	21.2	18.2	21
Monroe Co	Monroe	Luna Pier				
		Sterling State Park	20.5			21
Kalamazoo-Battle Creek	Calhoun					
	Kalamazoo	Kalamazoo #1	22.6	19.1	16.9	20
		Kalamazoo #2	22.5	19.1	15.8	19
	Van Buren					
Lansing-East Lansing	Ingham	Lansing	17.1	19.5**	22.3*	20
	Clinton					
	Eaton					
Benton Harbor	Berrien	Coloma	26.2			26
Bay Co	Bay	Bay City	22.4	17.8	17.5	19
Missaukee Co	Missaukee	Houghton Lake	14.9	16.2	15.1	15
Manistee Co	Manistee	Manistee	19.2	16.9	14.9	17
Schoolcraft Co	Schoolcraft	Seney		19*	14.3	17
Chippewa Co	Chippewa	Sault Ste. Marie #1	8.3*			8

*Indicates the site does not have a complete year of data.

**Indicates site was moved during the year and concentrations were averaged together for both locations.

[10] The 98th percentile value was obtained from the USEPA AQS. To comparing calculated values, the 3-year 24-hour average is rounded to the nearest 1 $\mu g/m^3$.

Figures 7.11 through **7.14** illustrate the current annual mean $PM_{2.5}$ trend for each monitoring site in Michigan. For clarity, the monitoring sites within the Detroit-Warren-Flint CSA have been broken down into two graphs.

Figure 7.11 shows the 2019 levels in Wayne County remained below the $PM_{2.5}$ NAAQS standard. Historically, Dearborn has had the highest concentrations in the state, but W. Fort St. now has the highest concentrations. All sites are below the annual $PM_{2.5}$ NAAQS standard. The Gordie Howe International Bridge sites are included in these graphs.

Figure 7.12 contains the remainder of those sites in the Detroit-Warren-Flint CSA that are outside of Wayne County. These sites also show readings in 2019 are below the $PM_{2.5}$ NAAQS.

Figure 7.13 combines the $PM_{2.5}$ monitoring sites located in West Michigan-Grand Rapids-Muskegon-Holland CSA, Kalamazoo, and Benton Harbor MSAs. All sites are below the annual $PM_{2.5}$ NAAQS.

Figure 7.14 displays the remaining monitoring sites in the Northern Lower and Upper Peninsula. All sites are below the annual $PM_{2.5}$ NAAQS standard.

Figure 7.11: Detroit-Warren-Flint CSA (Wayne County Only)
Annual Arithmetic Means for $PM_{2.5}$ from 2014-2019

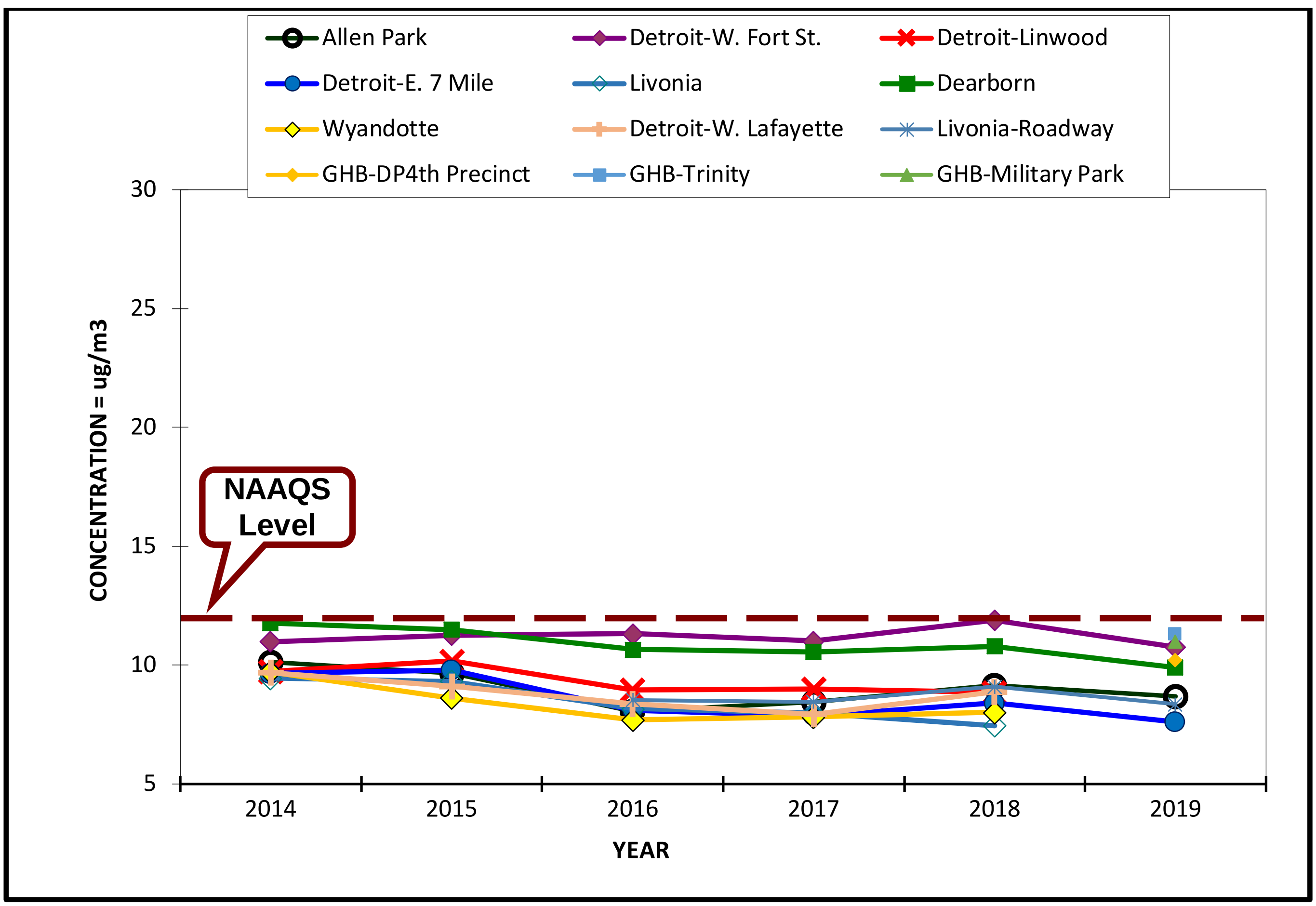


Figure 7.12: Detroit-Warren-Flint CSA (without Wayne County) Annual Arithmetic Means for $PM_{2.5}$ from 2014-2019

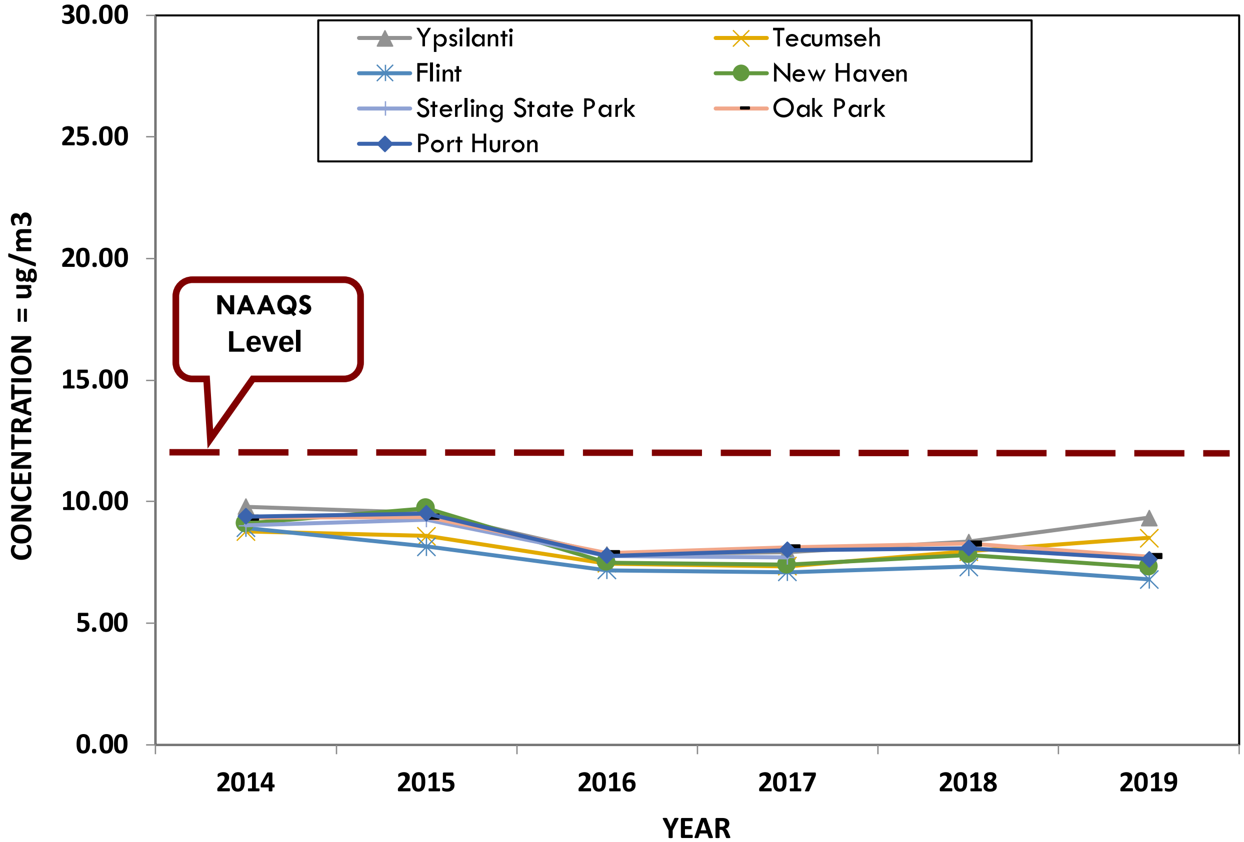


Figure 7.13: West MI - Grand Rapids-Muskegon-Holland CSA, Kalamazoo and Benton Harbor MSAs Annual Arithmetic Means for $PM_{2.5}$ from 2014-2019

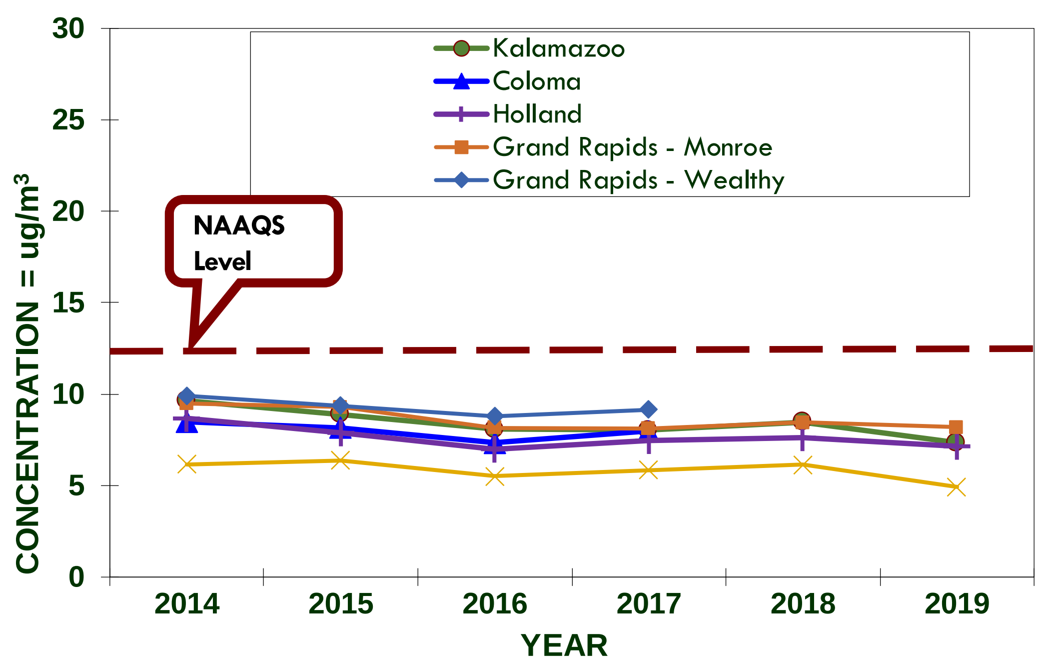
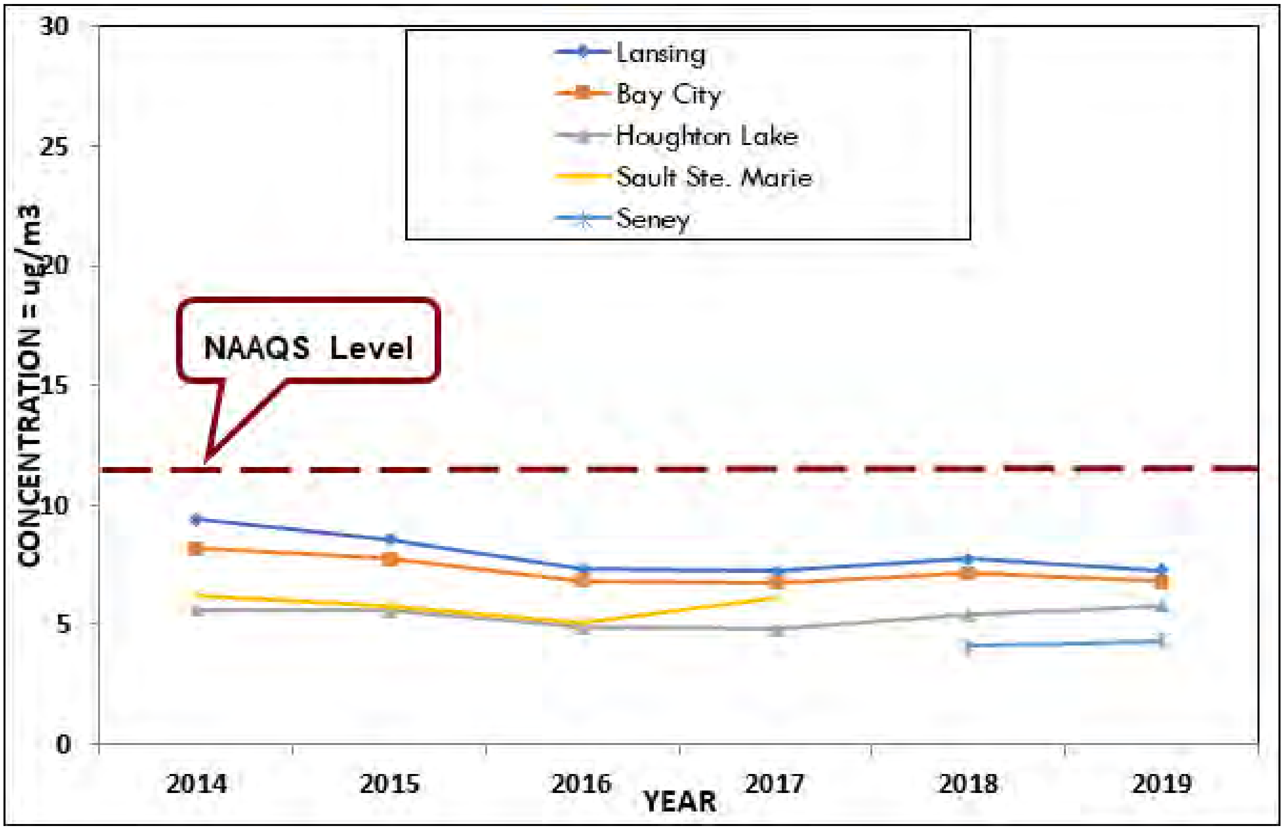


Figure 7.14: Lansing-E. Lansing CSA, Saginaw-Bay City CSA, Cadillac MiSA and Upper Peninsula Annual Arithmetic Means for $PM_{2.5}$ from 2014-2019



CHAPTER 8: TOXIC AIR POLLUTANTS

In addition to the six criteria pollutants discussed in previous chapters, the AQD monitors for a wide variety of substances classified as toxic air pollutants, and/or Hazardous Air Pollutants (HAPs). Under the Clean Air Act, the USEPA specifically addresses a group of 187 HAPs. Under Michigan's air regulations, Toxic Air Contaminants (TACs) are defined as all non-criteria pollutants that may be "*…harmful to public health or the environment when present in the outdoor atmosphere in sufficient quantities and duration.*" The definition of TACs lists 42 substances that are not TACs, indicating that all others are TACs. The sources and effects of toxics are as follows:

Sources: Air toxics come from a variety of mobile, stationary, and indoor man-made sources as well as outdoor natural sources. Mobile sources include motor vehicles, stationary sources include industrial factories and power plants, indoor sources include household cleaners, and natural sources include forest fires and eruptions from volcanoes.

Effects: Once air toxics enter the body, there is a wide range of potential health effects. They include: the aggravation of asthma; irritation to the eyes, nose, and throat; carcinogenicity; developmental toxicity (birth defects); nervous system effects; and various other effects on internal organs. Some effects appear after a shorter period of exposure, while others may appear after long-term exposure or after a long period of time has passed since the exposure ended. Most toxic effects are not unique to one substance, and some effects may be of concern only after the substance has deposited to the ground or to a water body (e.g., mercury, dioxin), followed by exposure through an oral pathway such as the eating of fish or produce. This further complicates the assessment of air toxics concerns due to the broad range of susceptibility that various people may have.

Population most at risk: People with asthma, children, and the elderly are generally at the highest risk for health effects from exposure to air toxics.

Air Toxics can be categorized as:

- **Metals:** Examples include aluminum, arsenic, beryllium, barium, cadmium, chromium, cobalt, copper, iron, mercury, manganese, molybdenum, nickel, lead, vanadium, and zinc.
- **Organic Substances:** Further divided into sub-categories that include -
    - VOCs, include benzene (found in gasoline), perchloroethylene (emitted from some dry-cleaning facilities), and methylene chloride (a solvent and paint stripper used by industry);
    - carbonyl compounds (formaldehyde, acetone, and acetaldehyde);
    - semi-volatile compounds (SVOCs);
    - polycyclic aromatic hydrocarbons (PAHs)/polynuclear aromatic hydrocarbons (PNAs);
    - pesticides and;
    - polychlorinated biphenyls (PCBs).

Other substances: Asbestos, dioxin, and radionuclides such as radon.

Because air toxics are such a large and diverse group of substances, regulatory agencies sometimes further refine these classifications to address specific concerns.

For example:

- Some initiatives have targeted those substances that are persistent, bioaccumulative and toxic (PBT), such as mercury, which accumulates in body tissues.
- The USEPA has developed an Integrated Urban Air Toxics Strategy with a focus on 30 substances (the Urban HAPs List).[11]

The evaluation of air toxics levels is difficult due to several factors.

- There are no health-protective NAAQS. Instead, air quality assessments utilize various short- and long-term screening levels and health-based levels estimated to be safe considering the critical effects of concern for specific substances.
- There is incomplete toxicity information for many substances. For some air toxics, the analytical detection limits are too high to consistently measure the amount present, and in some cases, the risk assessment-based levels are below the detection limits.
- Data gaps are present regarding the potential for interactive toxic effects for co-exposure to multiple substances present in emissions and in ambient air. Air toxics also pose a challenge due to monitoring and analytical methods that are either unavailable for some compounds or cost-prohibitive for others (e.g., dioxins).

These factors make it difficult to accurately assess the potential health concerns of all air toxics. Nevertheless, it is feasible and important to characterize the potential health hazards and risks associated with many air toxics.

Table 8.1 shows the monitoring stations and what air toxic was monitored at each station in 2019. This table can also be found in **Appendix B** with the Air Toxics Monitoring Summary.

The PM_{10} metals sampling for Mn was also shut down at River Rouge to reduce cost and workload. TSP Metals were added to the three new GHB sites, DP4th Precinct, Military Park, and Trinity.

[11] USEPA's Air Toxics website: Urban Strategy is located at www.epa.gov/urban-air-toxics.

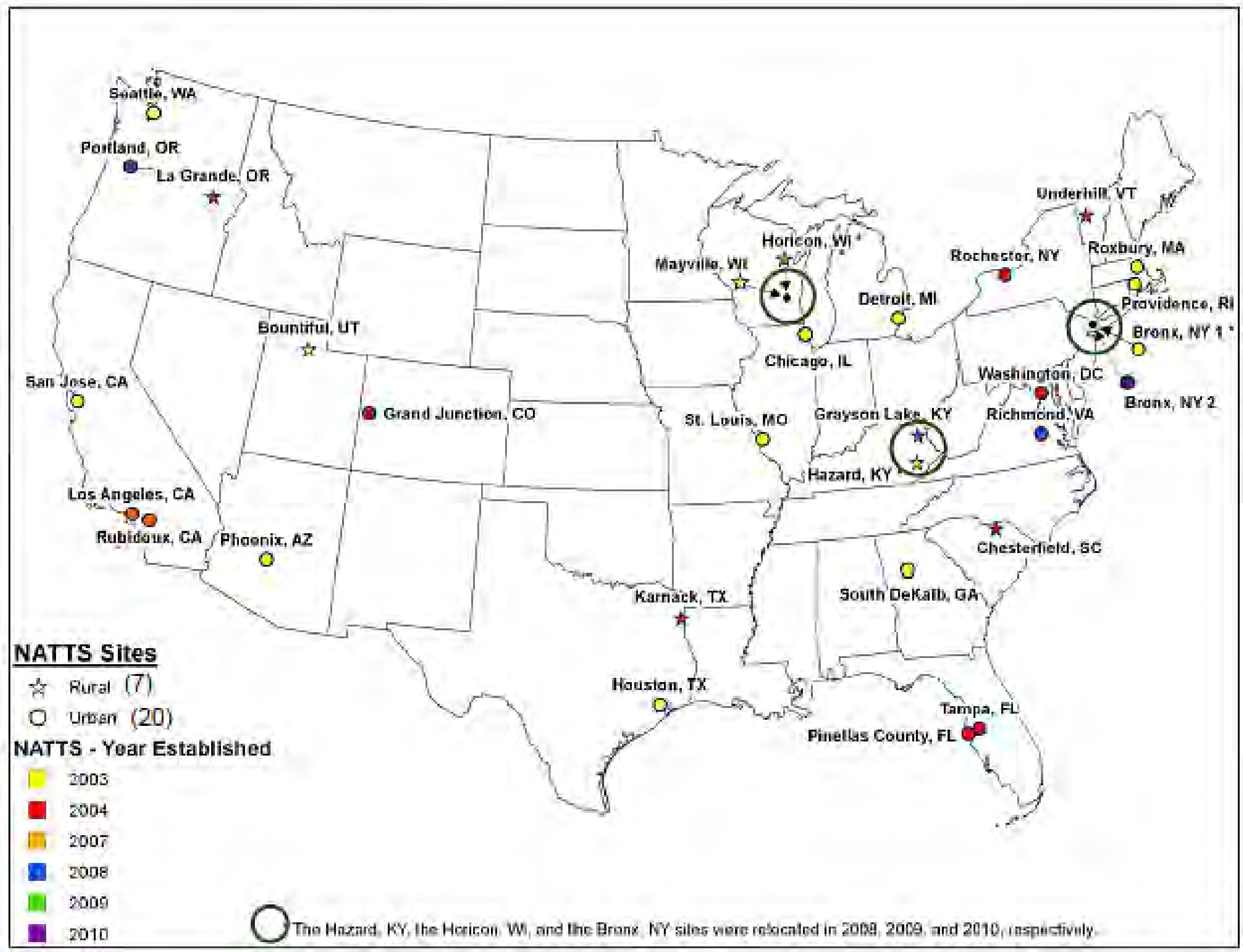
Table 8.1: 2019 Toxics Sampling Sites

Site Name	VOC	Carbonyl	PAHs	Metals TSP	Metals PM_{10}	Speciated $PM_{2.5}$
Allen Park				x		x
Dearborn	x	x	x	x	x	x
Detroit-W. Fort St.	x	x		x		x
Detroit-W. Jefferson				x		
Grand Rapids-Monroe				x		x
Belding-Merrick St.				x		
NMH 48217				x		
Port Huron-Rural St.				x		
River Rouge		x		x		
GHB-DP4th Precinct				x		
GHB-Military Park				x		
GHB-Trinity				x		

National Monitoring Efforts and Data Analysis

The USEPA administers national programs that identify air toxics levels, detect trends, and prioritize air toxics research. EGLE participates in these programs. In addition, the AQD operates a site in Dearborn that is part of the USEPA's NATTS. The purpose of the NATTS network is to detect trends in high-risk air toxics such as benzene, formaldehyde, chromium, and 1,3-butadiene and to measure the progress of air toxics regulatory programs at the national level. Currently, the NATTS network contains 27 stations; 20 urban and 7 rural (see **Figure 8.1**). The USEPA requires that the NATTS sites measure VOCs, carbonyls, PAHs, and trace metals on a once-every-six-day sampling schedule. The Dearborn NATTS site measures trace metals as TSP, PM_{10}, and $PM_{2.5}$.

Figure 8.1: National Air Toxics Trends Sites



CHAPTER 9: METEOROLOGICAL INFORMATION

Figures 9.1 through **9.3** show average daily temperatures, and **Figures 9.4** through **9.6** show total monthly precipitation amounts compared to their climatic norms for sites in the Northern, Southern Lower and Upper Peninsula. These figures were constructed by averaging data from several National Weather Service stations and therefore are not meant to be representative of any one single location in Michigan. Instead, they are intended to depict the regional trends that occurred during the year 2019.

Figure 9.1: Southern Lower Peninsula Observed Average Monthly Temperatures vs. Normal Average Monthly Temperatures

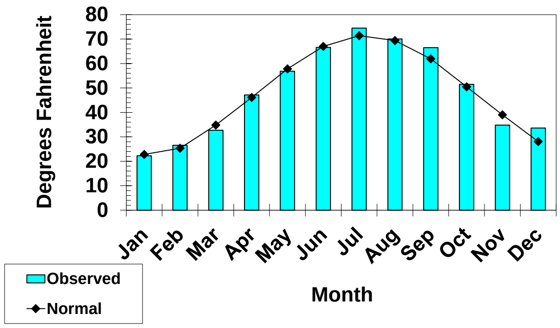


Figure 9.2: Northern Lower Peninsula Observed Average Monthly Temperatures vs. Normal Average Monthly Temperatures

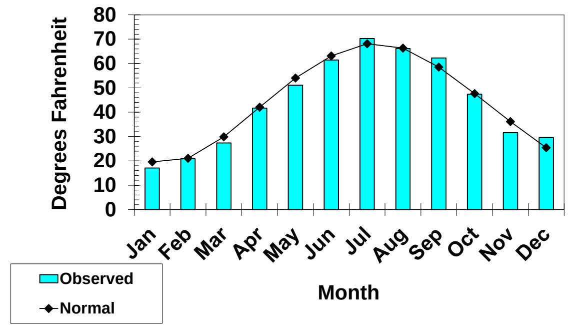


Figure 9.3: Upper Peninsula Observed Average Monthly Temperatures vs. Normal Average Monthly Temperatures

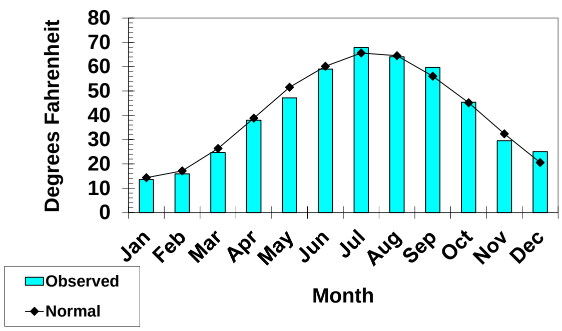


Figure 9.4: Southern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

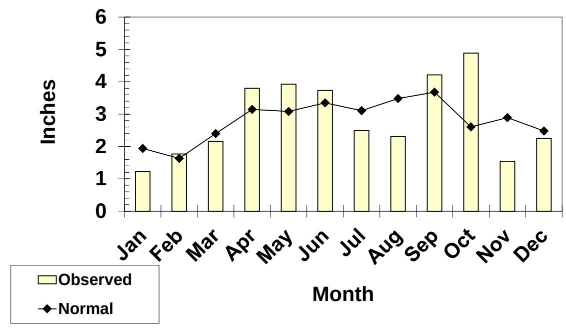


Figure 9.5: Northern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

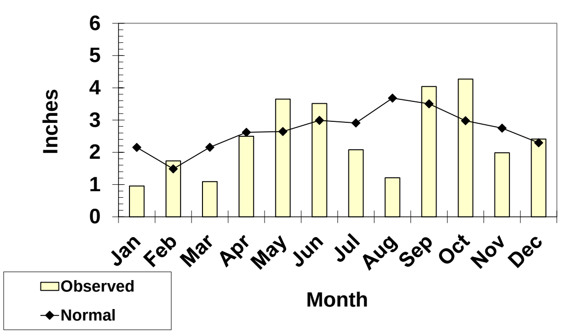
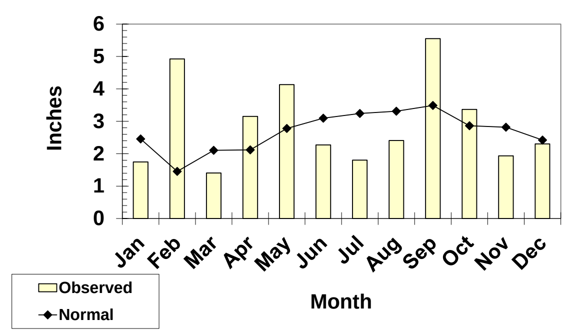


Figure 9.6: Upper Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation



CHAPTER 10: SPECIAL PROJECTS

EGLE completed the sampling for one special project and began a new project for the Gordie Howe International Bridge. Each of these projects are discussed below.

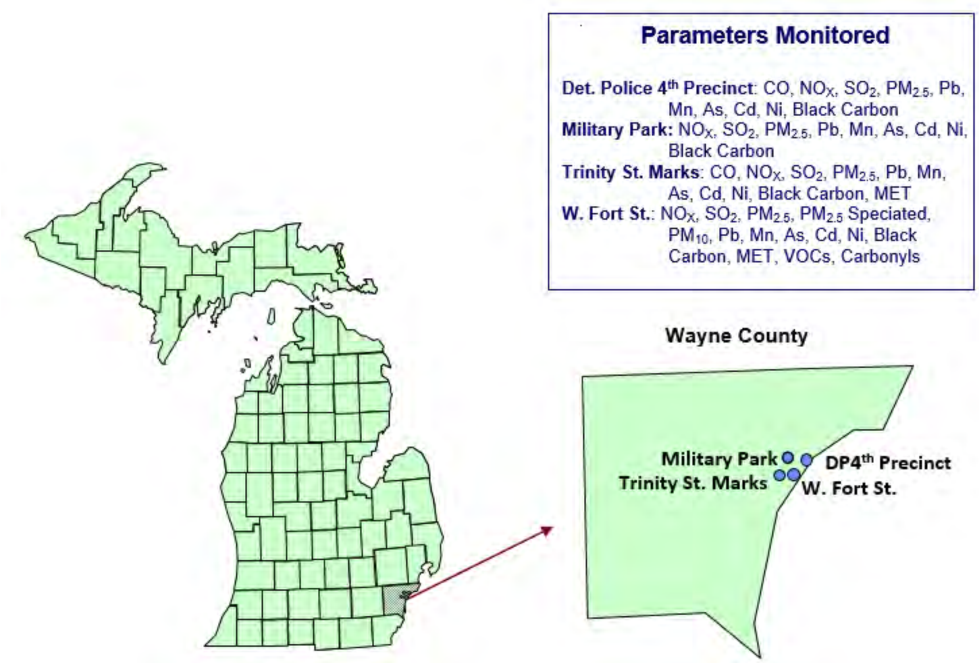
Near-road Air Toxics Grant: The Community Scale Air Toxics Ambient Monitoring (CSATAM) grant completed data collection in 2018 and the final report was received October 2019. This report can be found on EGLE's website under Monitoring[12].

Gordie Howe International Bridge Project: The second special purpose monitoring project is related to a joint Canadian-American venture. The Gordie Howe International Bridge will be built linking Windsor, Ontario and Detroit, Michigan. Construction is slated to begin in 2019-2020.

EGLE is conducting ambient air quality monitoring in the Delray community to ascertain air pollution levels in the community. The three new sites, indicated below, will monitor air pollutants before, during, and after construction of the bridge. In addition, NOx, continuous $PM_{2.5}$, and black carbon was added to the Detroit-W. Fort St. (261630015) monitoring site for this project.

- **Trinity (261630098):** meteorological parameters, NOx, SO_2, CO, continuous $PM_{2.5}$, black carbon, and five trace metals including lead.
- **DP4TH Precinct (261630099):** NOx, SO_2, CO, continuous $PM_{2.5}$, black carbon, and five trace metals including lead.
- **Military Park (261630100):** NOx, SO_2, continuous $PM_{2.5}$, black carbon, and five trace metals including lead.

Figure 10.1: Gordie Howe International Bridge Sites



The data from these sites is reported along with the other sites in the previous chapters and in the following appendices.

[12] For the full report Michigan.gov/documents/egle/egle-aqd-amu-detroit_near_road_air_pollution_eval_669319_7.pdf

APPENDIX A: CRITERIA POLLUTANT SUMMARY FOR 2019

Appendix A utilizes the USEPA's 2019 Air Quality System (AQS) Quick Look Report Data to present a summary of ambient air quality data collected for the criteria pollutants at monitoring locations throughout Michigan. Concentrations of non-gaseous pollutants are generally given in µg/m^3 and in ppm for gaseous pollutants. The following define some of the terms listed in the **Appendix A** reports.

Site I.D.: The AQS site ID is the USEPA's code number for these sites.

POC: The Parameter Occurrence Code or POC is used to assist in distinguishing different uses of monitors, i.e., under Pb, NO_2, and SO_2, POC #1-5 are used to help differentiate between individual monitors. For PM, the POC numbers are used more for the type of monitoring, such as:

- 1 - FRM;
- 2 - Co-located FRM;
- 3 - TEOM hourly PM_{10} and $PM_{2.5}$ measurements; and
- 5 - $PM_{2.5}$ speciation monitors (shown at right is a Met One SASS – speciation air sampling system).

 # OBS: For Pb, TSP, $PM_{2.5}$, and PM_{10}, the # OBS (number of observations) refers to the number of valid 24-hour values gathered.

For continuous monitors (CO, NO_2, O_3, $PM_{2.5}$ TEOM, BAM and SO_2), # OBS refers to the total valid hourly averages obtained from the analyzer.

Values: The value is listed for each criteria pollutant per its NAAQS (primary and secondary). The number of exceedances per site for the primary and secondary standards utilize running averages for continuous monitors (except for O_3) and does not include averages considered invalid due to limited sampling times. For example, a particulate-mean based only on six months could not be considered as violating the annual standard. As noted, each site is allowed one short-term standard exceedance before a violation is determined.

Criteria Pollutant Summary For 2019

CO measured in ppm

Site ID	POC	City	County	Year	# OBS	1-hr Highest Value	1-hr 2nd Highest Value	1-hr OBS > 35	8-hr Highest Value	8-hr 2nd Highest Value	8-hr OBS > 9
260810020	1	Grand Rapids-Monroe	Kent	2019	7901	1.7	1.7	0	1.3	1.3	0
261630001	1	Allen Park	Wayne	2019	8319	1.9	1.7	0	1.4	1.4	0
261630093	1	Eliza Howell-Roadway	Wayne	2019	7574	3.2	2.8	0	1.8	1.7	0
261630095	1	Livonia-Roadway	Wayne	2019	4099	2.1	1.8	0	1.4	1.2	0
261630098	1	GHB-DP4th Precinct	Wayne	2019	7599	5.6	3.9	0	3.0	1.8	0
261630099	1	GHB-Trinity*	Wayne	2019	8309	5.2	4.7	0	2.2	2.0	0

*Indicates site does not have a complete year of data.

Pb (24-hour) measured in $\mu g/m^3$

Site ID	POC	City	County	Year	# OBS	Highest rolling 3-month Arith Mean	Highest Value (24-hr)	2nd Highest Value (24-hr)
260670003	1	Belding-Merrick St.	Ionia	2019	61	0.09	0.752	0.194
260810020	1	Grand Rapids-Monroe	Kent	2019	60	0.01	0.045	0.011
261470031	1	Port Huron-Rural St.	St. Clair	2019	61	0.02	0.113	0.059
261630001	1	Allen Park	Wayne	2019	60	0.00	0.006	0.006
261630005	1	River Rouge	Wayne	2019	61	0.01	0.033	0.021
261630015	1	Detroit-W. Fort St.	Wayne	2019	59	0.02	0.062	0.039
261630027	1	Detroit-W. Jefferson	Wayne	2019	60	0.01	0.045	0.043
261630033	1	Dearborn	Wayne	2019	59	0.01	0.042	0.026
261630097	1	NMH 48217	Wayne	2019	61	0.01	0.018	0.009
261630098	1	GHB-DP4th Precinct	Wayne	2019	59	0.01	0.020	0.019
261630099	1	GHB-Trinity	Wayne	2019	60	0.03	0.303	0.040
261630100	1	GHB-Military Park	Wayne	2019	61	0.02	0.078	0.067

NO_2 measured in ppb

Site ID	POC	City	County	Year	# OBS	1-Hr Highest Value	1-Hr 2nd Highest Value	98th Percentile 1-hr	Annual Arith Mean
260650018	1	Lansing	Ingham	2019	8336	54.4	47.5	43.7	6.91
261130001	1	Houghton Lake	Missaukee	2019	7929	11.8	11.3	8.0	1.07
261390005	1	Jenison	Ottawa	2019	8145	50.0	45.0	36.0	5.65
261630015	1	Detroit-W. Fort St.	Wayne	2019	7424	55.5	53.5	50.1	14.05
261630093	1	Eliza Howell-Roadway	Wayne	2019	8105	56.2	51.7	45.4	15.55
261630095	1	Livonia–Roadway	Wayne	2019	4070	72.2	52.2	49.0	10.57*
261630098	1	GHB-DP4th Precinct	Wayne	2019	8270	60.7	56.1	49.6	14.83
261630099	1	GHB-Trinity	Wayne	2019	7781	55.3	49.9	46.1	13.86
161630100	1	GHB-Military Park	Wayne	2019	8312	54.7	53.3	47.3	12.92

*Indicates site does not have a complete year of data.

NO_Y measured in ppb

Site ID	POC	City	County	Year	# OBS	1-Hr Highest Value	1-Hr 2nd Highest Value	Annual Arith Mean
260810020	1	Grand Rapids-Monroe	Kent	2019	6935	210.0	200.0	11.40
261630001	1	Allen Park	Wayne	2019	7898	217.7	213.0	14.84
261630019	1	Detroit-E. 7 Mile	Wayne	2019	3474	109.7	77.5	9.17*

*Indicates site does not have a complete year of data.

O_3 (1-hour) measured in ppm

Site ID	POC	City	County	Year	Num Meas	Num Req	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Day Max >/= 0.125 Measured	Values >/= 0.125 Estimated	Missed Days < 0.125 Standard
260050003	1	Holland	Allegan	2019	245	245	0.093	0.084	0.081	0.078	0	0	0
260190003	1	Benzonia	Benzie	2019	238	245	0.072	0.072	0.066	0.065	0	0	0
260210014	1	Coloma	Berrien	2019	245	245	0.084	0.081	0.081	0.078	0	0	0
260270003	2	Cassopolis	Cass	2019	245	245	0.081	0.078	0.073	0.071	0	0	0
260370002	2	Rose Lake 2	Clinton	2019	233	245	0.066	0.063	0.060	0.060	0	0	0
260490021	1	Flint	Genesee	2019	245	245	0.070	0.070	0.065	0.065	0	0	0
260492001	1	Otisville	Genesee	2019	242	245	0.071	0.070	0.065	0.064	0	0	0
260630007	1	Harbor Beach	Huron	2019	245	245	0.077	0.075	0.074	0.068	0	0	0
260650018	1	Lansing-Filley St.	Ingham	2019	245	245	0.061	0.061	0.060	0.059	0	0	0
260770008	1	Kalamazoo	Kalamazoo	2019	242	245	0.072	0.068	0.067	0.067	0	0	1
260810020	1	Grand Rapids-Monroe	Kent	2019	354	365	0.077	0.075	0.072	0.068	0	0	2
260810022	1	Evans	Kent	2019	245	245	0.072	0.072	0.068	0.068	0	0	0
260910007	1	Tecumseh	Lenawee	2019	241	245	0.069	0.067	0.066	0.065	0	0	0
260990009	1	New Haven	Macomb	2019	244	245	0.084	0.081	0.079	0.079	0	0	1
260991003	1	Warren	Macomb	2019	241	245	0.080	0.078	0.073	0.071	0	0	1
261010922	1	Manistee	Manistee	2019	238	245	0.076	0.069	0.069	0.067	0	0	1
261050007	1	Scottville	Mason	2019	245	245	0.068	0.067	0.062	0.062	0	0	0

O_3 (1-hour) measured in ppm, continued

Site ID	POC	City	County	Year	Num Meas	Num Req	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Day Max >/= 0.125 Measured	Values >/= 0.125 Estimated	Missed Days < 0.125 Standard
261130001	1	Houghton Lake	Missaukee	2019	240	245	0.063	0.062	0.062	0.062	0	0	1
261210039	1	Muskegon	Muskegon	2019	244	245	0.091	0.080	0.080	0.078	0	0	1
261250001	2	Oak Park	Oakland	2019	245	245	0.088	0.085	0.083	0.076	0	0	0
261390005	1	Jenison	Ottawa	2019	245	245	0.080	0.074	0.071	0.069	0	0	0
261470005	1	Port Huron	St. Clair	2019	237	245	0.083	0.082	0.080	0.079	0	0	1
261530001	1	Seney	Schoolcraft	2019	245	245	0.077	0.068	0.066	0.063	0	0	0
261610008	1	Ypsilanti	Washtenaw	2019	245	245	0.087	0.076	0.071	0.071	0	0	0
261630001	2	Allen Park	Wayne	2019	342	365	0.072	0.072	0.069	0.067	0	0	2
261630019	2	Detroit-E. 7 Mile	Wayne	2019	242	245	0.083	0.081	0.081	0.077	0	0	0

* Indicates site was moved from Lansing to Lansing-Filley St.

O_3 (8-hour) measured in ppm

Site ID	POC	City	County	Year	% OBS	Valid Days Measured	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Day Max > 0.070
260050003	1	Holland	Allegan	2019	100	245	0.075	0.073	0.072	0.071	4
260190003	1	Benzonia	Benzie	2019	97	238	0.068	0.060	0.059	0.057	0
260210014	1	Coloma	Berrien	2019	100	245	0.074	0.071	0.069	0.066	2
260270003	2	Cassopolis	Cass	2019	100	245	0.067	0.065	0.064	0.064	0
260370002	1	Rose Lake 2	Clinton	2019	94	230	0.060	0.058	0.055	0.055	0
260490021	1	Flint	Genesee	2019	99	243	0.061	0.061	0.061	0.060	0
260492001	1	Otisville	Genesee	2019	98	241	0.062	0.062	0.060	0.060	0
260630007	1	Harbor Beach	Huron	2019	100	245	0.067	0.067	0.062	0.060	0
260650018	1	Lansing-Filley St.	Ingham	2019	100	245	0.057	0.057	0.057	0.055	0
260770008	1	Kalamazoo	Kalamazoo	2019	98	239	0.065	0.064	0.062	0.061	0
260810020	1	Grand Rapids	Kent	2019	96	352	0.067	0.067	0.066	0.065	0
260810022	1	Evans	Kent	2019	99	243	0.065	0.064	0.063	0.060	0
260910007	1	Tecumseh	Lenawee	2019	98	241	0.063	0.062	0.062	0.059	0
260990009	1	New Haven	Macomb	2019	100	244	0.071	0.064	0.063	0.063	1
260991003	1	Warren	Macomb	2019	98	240	0.070	0.068	0.067	0.062	0
261010922	1	Manistee	Manistee	2019	98	239	0.071	0.062	0.062	0.062	1
261050007	1	Scottville	Mason	2019	100	245	0.059	0.058	0.057	0.057	0
261130001	1	Houghton Lake	Missaukee	2019	98	239	0.059	0.059	0.058	0.058	0
261210039	1	Muskegon	Muskegon	2019	99	243	0.080	0.069	0.068	0.068	1
261250001	2	Oak Park	Oakland	2019	100	245	0.077	0.072	0.067	0.066	2
261390005	1	Jenison	Ottawa	2019	100	245	0.070	0.066	0.066	0.065	0
261470005	1	Port Huron	St. Clair	2019	96	236	0.073	0.072	0.072	0.070	3
261530001	1	Seney	Schoolcraft	2019	100	245	0.067	0.061	0.060	0.059	0
261610008	1	Ypsilanti	Washtenaw	2019	100	245	0.064	0.062	0.062	0.060	0
261630001	2	Allen Park	Wayne	2019	92	337	0.063	0.063	0.062	0.062	0
261630019	2	Detroit-E. 7 Mile	Wayne	2019	98	240	0.074	0.074	0.073	0.068	3

$PM_{2.5}$ (24-hour) FRM measured in $\mu g/m^3$ at local conditions

Site ID	POC	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	98%	Wtd. Arith. Mean
260050003	1	FRM	Holland	Allegan	2019	106	29.7	21.2	18.2	17.8	18.2	7.15
260170014	1	FRM	Bay City	Bay	2019	120	27.2	24.2	17.5	17.2	17.5	6.78
260490021	1	FRM	Flint	Genesee	2019	116	20.2	18.4	17.5	16.5	17.5	6.81
260650018	1	FRM	Lansing-Filley St.	Ingham	2019	54	23.7	22.3	20.9	19.0	22.3	7.27*
260770008	1	FRM	Kalamazoo	Kalamazoo	2019	106	25.8	17.8	16.9	16.7	16.9	7.35*
260770008	2	FRM	Kalamazoo	Kalamazoo	2019	60	28.3	17.8	16.7	15.8	17.8	6.83
260810020	1	FRM	Grand Rapids-Monroe	Kent	2019	113	26.5	25.1	23.2	21.0	23.2	8.20
260810020	2	FRM	Grand Rapids-Monroe	Kent	2019	54	25.1	18.9	17.9	14.8	18.9	7.20*
260990009	1	FRM	New Haven	Macomb	2019	119	28.5	20.0	18.7	18.7	18.7	7.30
261010922	1	FRM	Manistee	Manistee	2019	98	20.5	14.9	14.2	13.9	14.9	4.93*
261250001	1	FRM	Oak Park	Oakland	2019	115	28.3	21.7	18.2	17.8	18.2	7.74
261390005	1	FRM	Jenison	Ottawa	2019	114	30.1	29.4	24.4	22.9	24.4	8.30
261470005	1	FRM	Port Huron	St. Clair	2019	117	27.4	21.6	20.3	19.5	20.3	7.64
261610008	1	FRM	Ypsilanti	Washtenaw	2019	117	29.4	22.7	21.2	20.2	21.2	8.33
261610008	2	FRM	Ypsilanti	Washtenaw	2019	58	29.7	22.9	15.6	15.3	22.9	7.57
261630001	1	FRM	Allen Park	Wayne	2019	227	29.1	26.9	22.3	22.1	22.0	8.69
261630015	1	FRM	Detroit-W. Fort St.	Wayne	2019	103	29.9	23.0	22.5	20.7	22.5	10.76*
261630019	1	FRM	Detroit-E. 7 Mile	Wayne	2019	115	28.2	20.6	19.6	18.1	19.6	7.61
261630033	1	FRM	Dearborn	Wayne	2019	118	34.6	24.0	24.0	22.4	24.0	9.90
261630033	2	FRM	Dearborn	Wayne	2019	55	34.7	24.2	20.7	19.8	24.2	9.08
261630095	1	FRM	Livonia-Roadway	Wayne	2019	59	30.5	22.8	19.5	15.1	22.8	8.36*

*Indicates the site does not have a complete year of data.

$PM_{2.5}$ (24-hour) FEM measured in µg/m³ at local conditions

Site ID	POC	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	98%	Wtd. Arith. Mean
260490021	3	BAM	Flint	Genesee	2019	318	22.2	20.4	19.3	19.1	18.6	7.33*
260910007	3	BAM	Tecumseh	Lenawee	2019	358	30.8	28.9	25.4	25.3	22.7	8.44
261130001	3	BAM	Houghton Lake	Missaukee	2019	327	21.7	21.0	20.9	20.7	15.1	5.79*
261530001	3	BAM	Seney	Schoolcraft	2019	347	23.2	21.1	18.1	16.8	14.1	4.25
261610008	3	BAM	Ypsilanti	Washtenaw	2019	184	26.2	24.8	23.8	22.0	22.0	8.60*

* Indicates the site does not have a complete year of data.

$PM_{2.5}$ Continuous, Non-Regulatory (1-Hour) Measured in µg/m³

Site ID	POC	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd. Arith. Mean
260170014	3	TEOM	Bay City	Bay	2019	6955	50.0	39.0	35.0	34.0	6.66
260650012	3	TEOM	Lansing-Filley St.	Ingham	2019	7774	63.8	63.7	60.3	45.6	7.43
260770008	3	TEOM	Kalamazoo	Kalamazoo	2019	7722	53.0	42.0	40.0	36.0	7.54
260810020	3	TEOM	Grand Rapids-Monroe	Kent	2019	7461	155.0	69.0	56.0	45.0	7.58
261470005	3	TEOM	Port Huron	St. Clair	2019	7790	56.0	53.0	45.0	44.0	7.49
261630001	3	TEOM	Allen Park	Wayne	2019	6415	62.0	53.0	53.0	51.0	8.49
261630015	3	BAM	Detroit-W. Fort St.	Wayne	2019	8345	270.6	227.9	188.8	183.8	12.60
261630033	3	TEOM	Dearborn	Wayne	2019	6502	72.0	66.0	52.0	45.0	9.54*
261630097	3	TEOM	NMH 48217	Wayne	2019	6472	75.7	71.2	71.2	65.7	8.33*
261630098	3	BAM	GHB-DP4th Precinct	Wayne	2019	8727	157.9	137.0	128.3	104.6	10.27
261630099	3	BAM	GHB-Trinity	Wayne	2019	8680	157.9	137.0	128.3	104.6	11.35
261630100	3	BAM	GHB-Military Park	Wayne	2019	8731	388.0	263.6	171.3	151.3	11.04

* Indicates the site does not have a complete year of data.

PM10 (24-hour) measured in µg /m3

Site ID	POC	Monitor	City	County	Year	# OBS	# Req.	ValidDays	% OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd Arith Mean
260810020	1	GRAV	Grand Rapids-Monroe	Kent	2019	57	61	57	93	104	49	43	35	15.9*
261390005	1	GRAV	Jenison	Ottawa	2019	59	61	59	97	180	104	68	50	17.2
261630001	1	GRAV	Allen Park	Wayne	2019	59	61	57	93	29	24	24	24	13.1*
261630015	1	GRAV	Detroit-W. Fort St.	Wayne	2019	60	61	60	98	67	65	63	55	25.3
261630033	1	GRAV	Dearborn	Wayne	2019	60	61	56	92	45	44	41	38	20.5
261630033	9	GRAV	Dearborn	Wayne	2019	34	30	27	90	44	38	35	33	20.4*

PM_{10} TEOM (1-hour) measured in µg/m^3

Site ID	POC	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd. Arith. Mean
261630033	3	TEOM	Dearborn	Wayne	2019	8457	48	47	42	42	17.5

$PM_{10-2.5}$ (24-hour) measured in µg/m^3

Site ID	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd. Arith. Mean
260810020	GRAV	Grand Rapids-Monroe	Kent	2019	94	21.7	21.3	15.8	14.3	6.46*
261630001	GRAV	Allen Park	Wayne	2019	103	25.6	19.5	17.0	16.2	7.33*

SO_2 measured in ppb

Site ID	POC	City	County	Year	# OBS	1-hr Highest Value	1-hr 2nd Highest Value	99th %ile: 1-hr	24-hr Highest Value	24-hr 2nd Highest Value	OBS >0.5	Arith Mean
260650018	1	Lansing-Filley St.	Ingham	2019	8363	4.2	3.9	3.5	1.8	1.7	0	0.84
260810020	2	Grand Rapids-Monroe	Kent	2019	8299	4.4	4.4	2.4	1.0	0.9	0	0.40
261150006	1	Sterling State Park	Monroe	2019	8229	10.9	9.6	8.8	3.4	3.0	0	0.64
261390011	1	West Olive	Ottawa	2019	8275	93.1	18.6	13.6	6.2	5.3	0	0.58
261470005	1	Port Huron	St. Clair	2019	8353	73.4	71.9	63.9	16.3	14.4	0	2.52
261630001	1	Allen Park	Wayne	2019	8227	33.0	26.2	21.5	4.8	4.1	0	0.66
261630015	1	Detroit-W. Fort St.	Wayne	2019	8330	68.2	65.3	60.7	16.1	15.7	0	3.03
261630097	1	NMH 48217	Wayne	2019	8316	34.8	33.2	26.6	7.3	7.1	0	0.97
261630098	1	GHB-DP4th Precinct	Wayne	2019	8324	28.6	26.2	18.9	5.9	5.4	0	1.07
261630099	1	GHB-Trinity	Wayne	2019	8365	46.2	42.0	26.0	11.5	6.6	0	1.15
261630100	1	GHB-Military Park	Wayne	2019	8352	37.4	34.2	31.9	12.2	9.4	0	0.81

APPENDIX B: 2019 AIR TOXICS MONITORING SUMMARY FOR METALS, VOCS, CARBONYL COMPOUNDS, PAHS, HEXAVALENT CHROMIUM & SPECIATED $PM_{2.5}$

Appendix B provides summary statistics of ambient air concentrations of various substances monitored in Michigan during 2019. At each monitoring site, air samples were taken over a 24-hour period (midnight to midnight). These air samples represent the average air concentration during that 24-hour period. The frequency of air samples collected is typically done once every 6 or 12 days. Sometimes the sampled air concentration is lower than the laboratory's analytical method detection level (MDL). When the concentration is lower than the MDL, two options are used to estimate the air concentration. The calculation of the minimum average ("Average (ND=0)") uses 0.0 µg/m³ for a value less than the MDL. In the calculation of the maximum average ("Average (ND=MDL/2)") the MDL divided by 2 (i.e., ½ the MDL) is substituted for air concentrations less than the MDL.

Table B shows the monitoring stations and what types of air toxics were monitored at each station in 2019. The following terms and acronyms are used in **Appendix B-1** and **B-2** data tables:

- Num Obs: Number of Observations (number of daily air samples taken during the year)
- Obs>MDL: Number of daily samples above the MDL
- Average (ND=0): average air concentration in 2019, assuming daily samples below MDL were equal to 0.0 µg/m³.
- Average (ND=MDL/2): average air concentration in 2019, assuming daily samples below MDL were equal to one half the MDL.
- MDL: Analytical MDL in units of µg/m³
- Max1: Highest daily air concentration during 2019
- Max2: Second highest daily air concentration during 2019
- Max3: Third highest daily air concentration during 2019
- µg/m³: Micrograms per cubic meter (1,000,000 µg = 1 g)

Table B: 2019 Toxics Sampling Sites

SITE NAME	VOC	Carbonyl	PAHs	Metals TSP	Metals PM_{10}	Speciated $PM_{2.5}$
Allen Park				x	x	x
Dearborn	x	x	x	x	x	x
Detroit-W. Fort St.	x	x		x		x
Detroit-W. Jefferson				x		
Grand Rapids-Monroe				x		x
Belding-Merrick St.				x		
NMH 48217				x		
Port Huron-Rural St.				x		
River Rouge		x		x		
GHB-DP4th Precinct				x		
GHB-Military Park				x		
GHB-Trinity				x		

VOC = volatile organic compound; PAHs = polycyclic aromatic hydrocarbon; TSP = total suspended particulate
PM_{10} = particulate matter with aerodynamic diameter less than 10 µm; Mn = manganese.

APPENDIX B-1 DATA TABLES

Allen Park (261630001) Concentrations in micrograms per cubic meter (µg/m^3)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	60	60	0.00109	0.00109	0.0000342	0.00458	0.00304	0.00298
Arsenic Pm10 Stp	30	30	0.000687	0.000687	0.000033	0.00404	0.00123	0.00119
Cadmium (Tsp) Stp	60	60	0.000119	0.000119	0.0000161	0.00035	0.00032	0.00026
Cadmium Pm10 Stp	30	30	0.000166	0.000166	0.0000133	0.00077	0.00036	0.00033
Lead (Tsp) Lc Frm/Fem	60	60	0.00306	0.00306		0.0067	0.00655	0.00595
Lead Pm10 Lc	30	30	0.00182	0.00182		0.0036	0.0033	0.00307
Manganese (Tsp) Stp	60	60	0.0185	0.0185	0.000614	0.0504	0.0421	0.0374
Manganese Pm10 Stp	28	28	0.00795	0.00795	0.000181	0.0241	0.0174	0.0163
Nickel (Tsp) Stp	60	60	0.00116	0.00116	0.000592	0.00597	0.00292	0.00263
Nickel Pm10 Stp	30	30	0.000739	0.000739	0.000542	0.00123	0.00113	0.00105

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m3)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
1,1,2,2-Tetrachloroethane	58	8	0.00661	0.0516	0.105	0.0748	0.0645	0.0597
1,1,2-Trichloroethane	58	2	0.000216	0.0302	0.0622	0.00655	0.006	0
1,1-Dichloroethane	58	5	0.000705	0.0143	0.0296	0.0146	0.00809	0.00688
1,1-Dichloroethylene	58	0	0	0.0246	0.0492	0	0	0
1,2,4-Trichlorobenzene	58	18	0.00907	0.292	0.893	0.0423	0.0416	0.0356
1,2,4-Trimethylbenzene	58	58	0.927	0.927	0.125	4.61	4.21	3.52
1,2-Dichlorobenzene	58	8	0.000674	0.0768	0.175	0.00541	0.00541	0.00481
1,2-Dichloropropane	58	3	0.000971	0.0252	0.0513	0.0226	0.018	0.0157
1,3,5-Trimethylbenzene	58	58	0.272	0.272	0.0539	1.41	1.23	1.18
1,3-Butadiene	58	57	0.0487	0.0489	0.0243	0.182	0.124	0.0943
1,3-Dichlorobenzene	58	2	0.00106	0.074	0.151	0.0583	0.00301	0
1,4-Dichlorobenzene	58	21	0.0179	0.0752	0.168	0.24	0.155	0.0848
2,5-Dimethylbenzaldehyde	17	0	0	0.00339	0.00678	0	0	0
9-Fluorenone (Tsp) Stp	13	13	0.000976	0.000976	4.04E-05	0.00261	0.00138	0.00136
Acenaphthene (Tsp) Stp	59	56	0.0065	0.0065	0.000132	0.0308	0.0256	0.0248
Acenaphthylene (Tsp) Stp	59	55	0.000308	0.000309	8.72E-06	0.00129	0.00116	0.000881
Acetaldehyde	65	65	1.94	1.94	0.0345	2.96	2.91	2.89
Acetone	65	65	2.78	2.78	0.507	6.73	6.08	5.67
Acetonitrile	58	58	0.496	0.496	0.105	1.41	1.35	1.15
Acetylene	61	56	0.61	0.612	0.0883	3.56	2.85	1.94
Acrylonitrile	58	16	0.0382	0.0554	0.0475	0.243	0.194	0.193
Anthracene (Tsp) Stp	59	58	0.000376	0.000376	3.47E-05	0.00184	0.00171	0.0011
Arsenic (Tsp) Stp	91	91	0.00195	0.00195	4.50E-05	0.0234	0.0175	0.0108
Arsenic Pm10 Stp	94	94	0.00111	0.00111	5.35E-05	0.0029	0.00286	0.0028
Barium (Tsp) Stp	91	91	0.0311	0.0311	0.00645	0.265	0.248	0.201
Barium PM_{10} Stp	90	90	0.0112	0.0112	5.81E-04	0.0225	0.0215	0.0207
Benzaldehyde	65	65	0.171	0.171	0.00788	0.42	0.405	0.369
Benzene	58	58	0.589	0.589	0.0314	1.35	1.23	1.04
Benzo[A]Anthracene (Tsp) Stp	59	59	0.000172	0.000172	9.32E-06	0.000802	0.000686	0.000539
Benzo[A]Pyrene (Tsp) Stp	59	59	0.000141	0.000141	1.43E-05	0.000375	0.000374	0.000356
Benzo[B]Fluoranthene (Tsp) Stp	59	58	0.000473	0.000473	8.32E-06	0.00204	0.00164	0.00137
Benzo[E]Pyrene (Tsp) Stp	59	59	0.000273	0.000273	5.51E-06	0.00108	0.00105	0.000808
Benzo[G,H,I]Perylene (Tsp) Stp	59	56	0.000209	0.000209	6.70E-06	0.000955	0.000539	0.000482

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m3) - continued

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Benzo[K]Fluoranthene (Tsp) Stp	59	58	0.000137	0.000137	4.21E-06	0.00056	0.000472	0.000383
Beryllium (Tsp) Stp	91	91	0.000119	0.000119	2.96E-05	0.00121	0.00117	0.00098
Beryllium PM_{10} Stp	95	88	1.89E-05	1.92E-05	8.86E-06	7.00E-05	7.00E-05	6.00E-05
Bromochloromethane	61	0	0	0.0249	0.0524	0	0	0
Bromodichloromethane	58	8	0.00617	0.0382	0.0744	0.0898	0.059	0.0583
Bromoform	58	20	0.00606	0.0431	0.124	0.0403	0.0279	0.0258
Bromomethane	58	49	0.0703	0.0733	0.0384	0.905	0.505	0.387
Butyraldehyde	63	63	0.882	0.882	0.0546	3.3	2.89	2.84
Cadmium (Tsp) Stp	91	91	0.000373	0.000373	2.25E-05	0.00356	0.00269	0.00264
Cadmium PM_{10} Stp	95	95	0.000216	0.000216	1.68E-05	0.00115	0.00112	0.0011
Carbon Disulfide	61	58	0.0708	0.0708	0.13	0.433	0.258	0.171
Carbon Tetrachloride	58	58	0.625	0.625	0.0686	1.03	0.937	0.818
Chlorobenzene	58	19	0.00596	0.0209	0.0453	0.0281	0.0249	0.0239
Chloroethane	58	32	0.02	0.0295	0.0425	0.117	0.0826	0.0602
Chloroform	58	58	0.817	0.817	0.0405	1.42	1.22	1.18
Chloromethane	58	58	1.21	1.21	0.0624	1.61	1.56	1.48
Chloroprene	61	0	0	0.0281	0.0592	0	0	0
Chromium (Tsp) Stp	91	91	0.00944	0.00944	0.00146	0.0972	0.0887	0.0779
Chromium PM_{10} Stp	95	95	0.00235	0.00235	0.00158	0.0048	0.00441	0.00425
Chrysene (Tsp) Stp	59	59	0.00041	0.00041	6.84E-06	0.0017	0.00137	0.00135
Cis-1,2-Dichloroethene	58	0	0	0.0666	0.133	0	0	0
Cis-1,3-Dichloropropene	58	0	0	0.0225	0.045	0	0	0
Cobalt (Tsp) Stp	91	91	0.000324	0.000324	3.96E-05	0.00299	0.00277	0.00229
Cobalt PM_{10} Stp	95	91	9.25E-05	9.32E-05	3.07E-05	0.00023	0.00021	0.0002
Copper (Tsp) Stp	91	91	0.0396	0.0396	0.00152	0.397	0.231	0.224
Copper PM_{10} Stp	95	95	0.0338	0.0338	0.000631	0.125	0.107	0.1
Coronene (Tsp) Stp	59	59	0.00011	0.00011	3.46E-06	0.000579	0.000229	0.000227
Crotonaldehyde	61	60	0.152	0.152	0.0102	0.876	0.735	0.62
Cyclopenta[Cd]Pyrene (Tsp) Stp	13	13	3.81E-05	3.81E-05	4.16E-06	0.00015	9.48E-05	3.82E-05
Dibenzo[A,H]Anthracene (Tsp) Stp	59	44	3.18E-05	3.35E-05	1.50E-05	0.000134	0.00011	8.93E-05
Dibromochloromethane	58	5	0.00113	0.0439	0.0947	0.0281	0.0162	0.0136
Dichlorodifluoromethane	58	58	2.31	2.31	0.183	2.97	2.73	2.67
Dichloromethane	58	58	5.39	5.39	0.173	58.4	15.4	13.5
Ethyl Acrylate	58	1	0.000498	0.00801	0.0153	0.0289	0	0
Ethylbenzene	58	58	0.368	0.368	0.073	2.62	0.869	0.79
Ethylene Dibromide	58	0	0	0.0507	0.101	0	0	0
Ethylene Dichloride	58	57	0.0764	0.0767	0.0348	0.108	0.105	0.105
Fluoranthene (Tsp) Stp	59	59	0.00447	0.00447	3.58E-05	0.0228	0.0202	0.0176

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m3) - continued

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Fluorene (Tsp) Stp	59	59	0.00594	0.00594	0.000135	0.0253	0.0238	0.023
Formaldehyde	65	65	2.86	2.86	0.0537	6.95	6.05	5.96
Freon 114	61	58	0.108	0.108	0.072	0.146	0.131	0.131
Hexachlorobutadiene	61	18	0.006	0.178	0.602	0.0277	0.0267	0.0224
Hexanaldehyde	64	62	0.0925	0.0927	0.0125	0.245	0.245	0.208
Indeno[1,2,3-Cd]Pyrene (Tsp) Stp	59	59	0.000215	0.000215	1.64E-05	0.00059	0.000503	0.000469
Iron (Tsp) Stp	91	91	2.05	2.05	0.023	17.1	17.1	17
Iron Pm10 Stp	95	95	0.571	0.571	0.00862	1.54	1.52	1.29
Isovaleraldehyde	17	0	0	0.0162	0.0324	0	0	0
Lead (Tsp) Lc Frm/Fem	90	90	0.00862	0.00862		0.043	0.0384	0.0267
Lead Pm10 Lc	95	95	0.00667	0.00667		0.0435	0.0421	0.0221
M/P Xylene	58	58	1.17	1.17	0.124	9.21	2.83	2.81
Manganese (Tsp) Stp	91	91	0.124	0.124	0.000795	1.19	1.08	1.01
Manganese PM_{10} Stp	95	95	0.0287	0.0287	0.000273	0.101	0.082	0.0761
Methyl Chloroform	58	29	0.00871	0.029	0.0813	0.03	0.0273	0.0256
Methyl Ethyl Ketone	62	62	0.396	0.396	0.317	0.931	0.869	0.828
Methyl Isobutyl Ketone	58	58	0.301	0.301	0.0418	0.848	0.75	0.701
Methyl Methacrylate	61	16	0.00569	0.0948	0.266	0.0565	0.0459	0.0438
Methyl Tert-Butyl Ether	58	1	0.000212	0.0283	0.0568	0.0123	0	0
Molybdenum (Tsp) Stp	91	91	0.00203	0.00203	0.000142	0.0373	0.0287	0.0136
Molybdenum PM_{10} Stp	95	95	0.000929	0.000929	0.000201	0.00395	0.0038	0.00254
Naphthalene (Tsp) Stp	59	59	0.0687	0.0687	0.00221	0.181	0.161	0.148
Nickel (Tsp) Stp	91	91	0.00347	0.00347	0.000767	0.0723	0.0281	0.0182
Nickel PM_{10} Stp	93	93	0.00135	0.00135	0.000986	0.00786	0.00287	0.00258
N-Octane	61	58	0.119	0.119	0.109	0.279	0.266	0.255
O-Xylene	58	58	0.396	0.396	0.0846	2.26	0.921	0.829
Perylene (Tsp) Stp	59	35	1.74E-05	1.93E-05	1.05E-05	8.55E-05	6.93E-05	6.87E-05
Phenanthrene (Tsp) Stp	59	59	0.0115	0.0115	0.000224	0.0477	0.0449	0.0406
Propionaldehyde	65	65	0.409	0.409	0.0693	1.02	0.805	0.745
Propylene	61	58	0.48	0.48	0.168	1.23	1.17	1.04
Pyrene (Tsp) Stp	59	59	0.00228	0.00228	5.35E-05	0.00916	0.00811	0.00811
Retene (Tsp) Stp	13	13	0.000192	0.000192	0.000347	0.000422	0.000293	0.000282
Styrene	58	57	0.533	0.533	0.0643	4.98	1.77	1.56
Tert-Butyl Ethyl Ether	61	2	0.000178	0.0144	0.0309	0.00627	0.0046	0
Tetrachloroethylene	58	58	0.25	0.25	0.0812	1.42	1.35	1.04
Tolualdehydes	5	2	0.0876	0.0974	0.0323	0.312	0.126	0
Toluene	58	58	0.987	0.987	0.0686	2.85	2.38	2.25
Trans-1,2-Dichloroethylene	58	16	0.00446	0.0211	0.046	0.103	0.0214	0.019

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m3) - continued

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Trans-1,3-Dichloropropene	58	1	0.00061	0.0314	0.0626	0.0354	0	0
Trichloroethylene	58	29	0.0159	0.0324	0.0661	0.0639	0.0586	0.058
Trichlorofluoromethane	58	58	1.25	1.25	0.0676	1.64	1.59	1.51
Valeraldehyde	64	63	0.0792	0.0793	0.012	0.183	0.166	0.165
Vanadium (Tsp) Stp	91	91	0.00437	0.00437	6.44E-05	0.0538	0.0376	0.0338
Vanadium PM_{10} Stp	94	94	0.00113	0.00113	5.38E-05	0.00843	0.00248	0.00246
Vinyl Chloride	58	3	0.000366	0.0127	0.0261	0.0133	0.00511	0.00281
Zinc (Tsp) Stp	91	91	0.183	0.183	0.00509	2.12	0.984	0.892
Zinc PM_{10} Stp	94	94	0.0935	0.0935	0.00199	0.527	0.394	0.388

Detroit-W. Fort St. (N. Delray-SWHS) (261630015) Concentrations in micrograms per cubic meter (µg/m^3)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
1,1,2,2-Tetrachloroethane	29	0	0	0.161	0.323	0	0	0
1,1,2-Trichloroethane	29	0	0	0.049	0.0981	0	0	0
1,1-Dichloroethane	29	0	0	0.0857	0.171	0	0	0
1,1-Dichloroethylene	29	0	0	0.0778	0.156	0	0	0
1,2,4-Trichlorobenzene	29	0	0	0.693	1.39	0	0	0
1,2,4-Trimethylbenzene	29	1	0.0203	0.169	0.307	0.59	0	0
1,2-Dichlorobenzene	29	0	0	0.184	0.369	0	0	0
1,2-Dichloropropane	29	0	0	0.55	1.1	0	0	0
1,3,5-Trimethylbenzene	29	0	0	0.12	0.24	0	0	0
1,3-Butadiene	29	0	0	0.06	0.12	0	0	0

Detroit-W. Fort St. (N. Delray-SWHS) (261630015) Concentrations in micrograms per cubic meter (µg/m³)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
1,3-Dichlorobenzene	29	0	0	0.141	0.283	0	0	0
1,4-Dichlorobenzene	29	0	0	0.193	0.386	0	0	0
2,2,4-Trimethylpentane	29	0	0	0.0734	0.147	0	0	0
Acetaldehyde	30	30	2.06	2.06		4.26	4.06	2.9
Acetone	30	30	2.95	2.95		5.91	5.29	4.26
Acetonitrile	29	19	2.68	2.77	0.5	44	20	1.3
Acrolein - Unverified	30	28	0.0762	0.0816		0.129	0.122	0.115
Acrylonitrile	29	0	0	0.398	0.796	0	0	0
Arsenic (Tsp) Stp	61	61	0.0015	0.0015	0.0000345	0.00497	0.00402	0.00364
Benzaldehyde	30	30	0.27	0.27		0.616	0.497	0.48
Benzene	29	26	0.636	0.64	0.0951	2.7	1.2	1.1
Bromodichloromethane	29	0	0	0.075	0.15	0	0	0
Bromoform	29	0	0	0.174	0.349	0	0	0
Bromomethane	29	0	0	0.111	0.221	0	0	0
Cadmium (Tsp) Stp	61	61	0.000266	0.000266	0.0000163	0.00259	0.00077	0.00065
Carbon Tetrachloride	29	0	0	0.114	0.228	0	0	0
Chlorobenzene	29	0	0	0.103	0.207	0	0	0
Chloroethane	29	0	0	0.06	0.12	0	0	0
Chloroform	29	0	0	0.06	0.12	0	0	0
Chloromethane	29	28	1.34	1.34	0.16	2.5	2.3	2.2
Cis-1,2-Dichloroethene	29	0	0	0.0631	0.126	0	0	0
Cis-1,3-Dichloropropene	29	0	0	0.065	0.13	0	0	0
Crotonaldehyde	30	0	0			0	0	0
Dibromochloromethane	29	0	0	0.148	0.296	0	0	0
Dichlorodifluoromethane	29	28	2.24	2.25	0.251	2.7	2.6	2.5
Dichloromethane	29	11	0.215	0.323	0.347	1.1	0.79	0.74
Ethylbenzene	29	3	0.0641	0.195	0.293	0.76	0.6	0.5
Ethylene Dibromide	29	0	0	0.149	0.297	0	0	0
Ethylene Dichloride	29	0	0	0.0964	0.193	0	0	0
Formaldehyde	30	30	3.27	3.27		6.14	5.48	5.27
Hexanaldehyde	30	30	0.395	0.395		0.811	0.678	0.678
Lead (Tsp) Lc Frm/Fem	62	59	0.0112	0.0112		0.0626	0.0397	0.0358
M/P Xylene	29	9	0.32	0.574	0.737	1.3	1.3	1.2
Manganese (Tsp) Stp	62	62	0.0587	0.0587	0.000612	0.2	0.197	0.168
Manganese PM_{10} Stp	28	28	0.0257	0.0257	0.000181	0.0804	0.0781	0.0565
Methacrolein	30	30	0.134	0.134		0.354	0.341	0.21
Methyl Chloroform	29	0	0	0.106	0.211	0	0	0
Methyl Ethyl Ketone	29	3	0.145	0.638	1.1	1.5	1.5	1.2
Methyl Isobutyl Ketone	29	0	0	0.432	0.864	0	0	0
Methyl Tert-Butyl Ether	29	1	0.0621	0.154	0.191	1.8	0	0

Detroit-W. Fort St. (N. Delray-SWHS) (261630015) -continued

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
N-Hexane	29	17	0.404	0.422	0.087	1.4	1.2	1
Nickel (Tsp) Stp	61	61	0.003	0.003	0.000598	0.00761	0.00731	0.0058
O-Xylene	29	6	0.151	0.282	0.331	1.3	0.74	0.69
Propionaldehyde	30	30	0.406	0.406		0.909	0.833	0.731
Styrene	29	21	12.3	12.4	0.77	140	98	84
Tetrachloroethylene	29	23	3.2	3.22	0.233	25	15	13
Tolualdehydes	30	2	0.00368	0.0552		0.0603	0.0501	0
Toluene	29	26	0.915	0.938	0.443	1.8	1.7	1.7
Trans-1,2-Dichloroethylene	29	1	0.0414	0.114	0.15	1.2	0	0
Trans-1,3-Dichloropropene	29	1	0.0483	0.0917	0.0901	1.4	0	0
Trichloroethylene	29	1	0.0552	0.136	0.167	1.6	0	0
Trichlorofluoromethane	29	28	1.38	1.39	0.231	2.3	2.1	2
Valeraldehyde	30	30	0.366	0.366		0.757	0.718	0.686
Vinyl Chloride	29	1	0.0269	0.0897	0.13	0.78	0	0

Detroit, W. Jefferson, South Delray (261630027) Concentrations in micrograms per cubic meter (μg/m^3)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	60	60	0.00171	0.00171	0.0000358	0.00499	0.00429	0.0036
Cadmium (Tsp) Stp	60	60	0.000317	0.000317	0.0000163	0.00312	0.0008	0.00068
Lead (Tsp) Lc Frm/Fem	61	60	0.0108	0.0108		0.046	0.0432	0.0265
Manganese (Tsp) Stp	60	60	0.151	0.151	0.000651	0.663	0.648	0.575
Nickel (Tsp) Stp	60	60	0.00301	0.00301	0.000628	0.00729	0.00718	0.00714

Port Huron-Rural St. (261470031), Speciated $PM_{2.5}$ ($\mu g/m^3$)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	61	61	0.00111	0.00111	0.0000346	0.0118	0.00831	0.00512
Cadmium (Tsp) Stp	61	60	0.0002	0.0002	0.0000162	0.00112	0.00091	0.00085
Lead (Tsp) Lc Frm/Fem	91	91	0.0176	0.0176		0.122	0.114	0.067
Manganese (Tsp) Stp	61	61	0.00726	0.00726	0.000622	0.0268	0.024	0.0195
Nickel (Tsp) Stp	61	61	0.000881	0.000881	0.000599	0.0025	0.0019	0.00182

River Rouge (261630005) Concentrations in micrograms per cubic meter ($\mu g/m^3$)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Acetaldehyde	30	30	2.52	2.52		3.78	3.66	3.09
Acetone	30	30	2.75	2.75		5.85	5.02	4.15
Acrolein - Unverified	30	29	0.0786	0.0813		0.141	0.137	0.125
Arsenic (Tsp) Stp	61	61	0.00155	0.00155	0.0000348	0.0118	0.00813	0.00341
Benzaldehyde	30	30	0.165	0.165		0.547	0.299	0.281
Cadmium (Tsp) Stp	61	61	0.000315	0.000315	0.0000163	0.0016	0.00092	0.00086
Crotonaldehyde	30	0	0			0	0	0
Formaldehyde	30	30	3.37	3.37		6.58	6.47	5.38
Hexanaldehyde	30	30	0.211	0.211		0.774	0.526	0.469
Lead (Tsp) Lc Frm/Fem	62	61	0.00615	0.00615		0.0332	0.0213	0.0174
Manganese (Tsp) Stp	61	61	0.0438	0.0438	6.33E-04	0.152	0.105	0.0999
Methacrolein	30	30	0.15	0.15		0.474	0.378	0.238
Nickel (Tsp) Stp	61	61	0.00131	0.00131	0.000609	0.00298	0.00252	0.00233
Propionaldehyde	30	30	0.385	0.385		1.01	0.837	0.649
Tolualdehydes	30	5	0.0117	0.0699		0.0865	0.0774	0.0702
Valeraldehyde	30	30	0.18	0.18		0.799	0.395	0.336

Grand Rapids-Monroe St. (260810020) Concentrations in micrograms per cubic meter (μg/m³)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	61	61	0.000853	0.000853	0.0000335	0.00515	0.00219	0.00214
Cadmium (Tsp) Stp	61	61	0.0000782	0.0000782	0.0000163	0.00025	0.00021	0.00018
Lead (Tsp) Lc Frm/Fem	62	60	0.00373	0.00373		0.0451	0.0118	0.0101
Manganese (Tsp) Stp	61	61	0.0102	0.0102	0.000593	0.0271	0.0264	0.0251
Nickel (Tsp) Stp	61	61	0.000966	0.000966	0.000572	0.00515	0.00253	0.00219

Belding-Merrick St. (260670003) Concentrations in micrograms per cubic meter (μg/m³)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	61	61	0.00107	0.00107	0.0000348	0.00482	0.00394	0.00343
Cadmium (Tsp) Stp	61	61	0.00102	0.00102	0.0000161	0.0413	0.00392	0.00326
Lead (Tsp) Lc Frm/Fem	61	61	0.0304	0.0304		0.753	0.195	0.152
Manganese (Tsp) Stp	61	61	0.0061	0.0061	0.00062	0.0177	0.0118	0.0116
Nickel (Tsp) Stp	61	61	0.000653	0.000653	0.000598	0.00189	0.00148	0.00124

NMH 48217 (261630097) Concentrations in micrograms per cubic meter (μg/m³)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	61	61	0.001	0.001	0.0000334	0.00292	0.00273	0.00234
Cadmium (Tsp) Stp	61	61	0.000143	0.000143	0.000016	0.00144	0.00039	0.00034
Lead (Tsp) Lc Frm/Fem	61	61	0.00436	0.00436		0.0181	0.00984	0.00954
Manganese (Tsp) Stp	61	61	0.0199	0.0199	0.000604	0.0422	0.0394	0.0387
Nickel (Tsp) Stp	61	61	0.0016	0.0016	0.000583	0.0202	0.00901	0.00513

DP 4th Precinct (261630098) Concentrations in micrograms per cubic meter (µg/m³)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	60	60	0.00112	0.00112	0.0000354	0.00265	0.00233	0.00227
Cadmium (Tsp) Stp	60	60	0.000159	0.000159	0.0000162	0.00138	0.00034	0.00034
Lead (Tsp) Lc Frm/Fem	60	59	0.00732	0.00732		0.0203	0.0192	0.0179
Manganese (Tsp) Stp	60	60	0.0485	0.0485	0.00063	0.13	0.123	0.121
Nickel (Tsp) Stp	60	60	0.00207	0.00207	0.000607	0.00578	0.00555	0.00502

Military Park (261630100) Concentrations in micrograms per cubic meter (µg/m³)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	61	61	0.00122	0.00122	0.0000343	0.00276	0.00273	0.00263
Cadmium (Tsp) Stp	61	61	0.000235	0.000235	0.0000161	0.00142	0.00093	0.00072
Lead (Tsp) Lc Frm/Fem	61	61	0.0117	0.0117		0.0782	0.0678	0.0661
Manganese (Tsp) Stp	61	61	0.0456	0.0456	0.000619	0.15	0.134	0.132
Nickel (Tsp) Stp	61	61	0.00145	0.00145	0.000595	0.00369	0.00312	0.00282

Trinity (261630099) Concentrations in micrograms per cubic meter (µg/m³)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (Tsp) Stp	61	61	0.00149	0.00149	0.0000341	0.00941	0.00391	0.00304
Cadmium (Tsp) Stp	61	61	0.000219	0.000219	0.0000161	0.00093	0.00053	0.00052
Lead (Tsp) Lc Frm/Fem	60	60	0.0145	0.0145		0.303	0.041	0.0285
Manganese (Tsp) Stp	61	61	0.08	0.08	0.000614	0.265	0.224	0.223
Nickel (Tsp) Stp	61	61	0.00271	0.00271	0.000592	0.00784	0.0076	0.00719

APPENDIX B-2 Data Tables

Allen Park (261630001), Speciated $PM_{2.5}$ (μg/m³)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND= MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	119	87	0.0274	0.0274	0.0322	0.14	0.134	0.12
Ammonium Ion Pm2.5 Lc	119	118	0.525	0.525	0.0069	4.17	2.66	2.39
Antimony Pm2.5 Lc	119	71	0.00497	0.00497	0.0388	0.0333	0.0278	0.0247
Arsenic Pm2.5 Lc	119	54	0.0000371	0.000201	0.00186	0.0021	0.00011	0.00011
Barium Pm2.5 Lc	119	66	0.0105	0.0105	0.08	0.0535	0.0426	0.0423
Bromine Pm2.5 Lc	119	25	0.000387	0.00218	0.00454	0.00741	0.00654	0.00478
Cadmium Pm2.5 Lc	119	70	0.00421	0.00421	0.0158	0.0212	0.0212	0.0188
Calcium Pm2.5 Lc	119	119	0.089	0.089	0.00882	0.472	0.462	0.454
Cerium Pm2.5 Lc	119	57	0.00916	0.00916	0.0953	0.0639	0.0514	0.0482
Cesium Pm2.5 Lc	119	61	0.00805	0.00805	0.0537	0.0666	0.0547	0.0431
Chlorine Pm2.5 Lc	119	105	0.0203	0.0203	0.00433	0.918	0.325	0.0658
Chromium Pm2.5 Lc	119	97	0.00338	0.00338	0.00275	0.0309	0.0303	0.022
Cobalt Pm2.5 Lc	119	42	0.00031	0.00031	0.0033	0.00276	0.00252	0.00199
Copper Pm2.5 Lc	119	102	0.0074	0.0074	0.0113	0.0396	0.0335	0.0328
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	120	120	0.438	0.438	0.0117	1.5	1.46	1.03
Indium Pm2.5 Lc	119	59	0.00471	0.00487	0.038	0.0447	0.034	0.0281
Iron Pm2.5 Lc	119	119	0.0989	0.0989	0.0175	0.333	0.328	0.322
Lead Pm2.5 Lc	119	82	0.0038	0.0038	0.0122	0.024	0.0151	0.0147
Magnesium Pm2.5 Lc	119	72	0.0208	0.0238	0.0462	0.121	0.114	0.112
Manganese Pm2.5 Lc	119	103	0.00329	0.00329	0.00639	0.0132	0.0124	0.0109
Nickel Pm2.5 Lc	119	96	0.00124	0.00124	0.00186	0.0081	0.00795	0.00747
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	120	120	1.91	1.91	0.358	5.17	4.94	3.94
Phosphorus Pm2.5 Lc	119	112	0.000408	0.000484	0.00258	0.00675	0.00494	0.00416
Potassium Ion Pm2.5 Lc	119	119	0.0364	0.0364	0.0606	0.419	0.18	0.134
Potassium Pm2.5 Lc	119	119	0.0486	0.0486	0.00631	0.18	0.146	0.135
Rubidium Pm2.5 Lc	119	55	0.00075	0.00075	0.00887	0.00858	0.00612	0.00604
Selenium Pm2.5 Lc	119	74	0.001	0.00102	0.00526	0.00598	0.00589	0.00543
Silicon Pm2.5 Lc	119	112	0.0729	0.0729	0.0176	0.418	0.385	0.37
Silver Pm2.5 Lc	119	59	0.0038	0.0038	0.0164	0.0244	0.0203	0.0193
Sodium Ion Pm2.5 Lc	119	118	0.0599	0.0599	0.00879	2.56	0.84	0.489
Sodium Pm2.5 Lc	119	82	0.0624	0.0624	0.0915	0.591	0.506	0.372
Strontium Pm2.5 Lc	119	76	0.00112	0.00112	0.00722	0.00639	0.0061	0.00573
Sulfate Pm2.5 Lc	119	119	0.905	0.905	0.0217	2.78	2.65	2.17

Allen Park (261630001), Speciated $PM_{2.5}$ ($\mu g/m^3$) - cotinued

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND= MDL/2)	MDL	Max 1	Max 2	Max 3
Sulfur Pm2.5 Lc	119	119	0.335	0.335	0.00371	0.997	0.902	0.836
Tin Pm2.5 Lc	119	65	0.00477	0.00477	0.0488	0.0403	0.0265	0.0251
Titanium Pm2.5 Lc	119	98	0.00363	0.00363	0.0035	0.0146	0.0139	0.0135
Total Nitrate Pm2.5 Lc	119	119	1.56	1.56	0.0394	12.4	8.33	7.77
Vanadium Pm2.5 Lc	119	33	0.000176	0.00066	0.00134	0.00188	0.00187	0.00142
Zinc Pm2.5 Lc	119	119	0.0165	0.0165	0.00316	0.151	0.057	0.0459
Zirconium Pm2.5 Lc	119	70	0.004	0.004	0.0359	0.0281	0.0261	0.0238

Dearborn (261630033), Speciated $PM_{2.5}$ (µg/m³)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	61	46	0.0336	0.0336	0.0322	0.255	0.122	0.122
Ammonium Ion Pm2.5 Lc	61	61	0.546	0.546	0.00684	2.4	2.33	1.57
Antimony Pm2.5 Lc	61	45	0.00674	0.00674	0.0388	0.0247	0.0212	0.018
Arsenic Pm2.5 Lc	61	26	2.03E-05	9.65E-05	0.00186	0.00011	0.00011	0.00006
Barium Pm2.5 Lc	61	35	0.0115	0.0115	0.0801	0.0679	0.056	0.0507
Bromine Pm2.5 Lc	61	25	0.000699	0.00204	0.00454	0.00927	0.00486	0.00413
Cadmium Pm2.5 Lc	61	33	0.00375	0.00375	0.0158	0.0176	0.0155	0.0143
Calcium Pm2.5 Lc	61	61	0.145	0.145	0.00887	0.864	0.836	0.624
Cerium Pm2.5 Lc	61	34	0.0127	0.0127	0.0954	0.079	0.0519	0.0505
Cesium Pm2.5 Lc	61	28	0.00574	0.00574	0.0538	0.036	0.0264	0.025
Chlorine Pm2.5 Lc	61	59	0.0391	0.0391	0.00433	0.271	0.222	0.177
Chromium Pm2.5 Lc	61	53	0.00259	0.00259	0.00276	0.0264	0.0128	0.00713
Cobalt Pm2.5 Lc	61	28	0.000569	0.000569	0.0033	0.00563	0.00336	0.00276
Copper Pm2.5 Lc	61	61	0.0259	0.0259	0.0114	0.0841	0.0711	0.0642
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	60	60	0.518	0.518	0.0117	1.17	1.17	1.01
Indium Pm2.5 Lc	61	38	0.00498	0.00498	0.0381	0.0266	0.0224	0.0179
Iron Pm2.5 Lc	61	61	0.359	0.359	0.0176	1.29	1.23	1.12
Lead Pm2.5 Lc	61	49	0.00614	0.00614	0.0122	0.0319	0.0188	0.0139
Magnesium Pm2.5 Lc	61	47	0.0387	0.041	0.0463	0.272	0.157	0.145
Manganese Pm2.5 Lc	61	57	0.0114	0.0114	0.0064	0.0421	0.0367	0.0347
Nickel Pm2.5 Lc	61	46	0.00137	0.00137	0.00186	0.0106	0.00729	0.00509
Oc Csn_Rev Unadjusted	60	60	2.1	2.1	0.356	4.6	4.36	4.29

Dearborn (261630033), Speciated $PM_{2.5}$ (µg/m^3) - continued

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Pm2.5 Lc Tot								
Phosphorus Pm2.5 Lc	61	57	0.000243	0.000343	0.00257	0.00605	0.00216	0.00141
Potassium Ion Pm2.5 Lc	61	61	0.0466	0.0466	0.0606	0.198	0.174	0.14
Potassium Pm2.5 Lc	61	61	0.0654	0.0654	0.00627	0.247	0.183	0.174
Rubidium Pm2.5 Lc	61	34	0.00128	0.00135	0.00888	0.00476	0.00473	0.00471
Selenium Pm2.5 Lc	61	42	0.0013	0.0013	0.00527	0.0042	0.00417	0.00393
Silicon Pm2.5 Lc	61	58	0.0889	0.0889	0.0177	0.706	0.361	0.345
Silver Pm2.5 Lc	61	36	0.00294	0.00294	0.0164	0.0158	0.0151	0.0124
Sodium Ion Pm2.5 Lc	61	61	0.0539	0.0539	0.00886	0.308	0.241	0.214
Sodium Pm2.5 Lc	61	48	0.0711	0.0711	0.0916	0.475	0.394	0.386
Strontium Pm2.5 Lc	61	33	0.0015	0.0015	0.00723	0.0178	0.0081	0.0077
Sulfate Pm2.5 Lc	61	61	1.15	1.15	0.0218	3.63	2.71	2.27
Sulfur Pm2.5 Lc	61	61	0.408	0.408	0.00372	1.16	1.02	0.889
Tin Pm2.5 Lc	61	35	0.00566	0.00566	0.0488	0.0339	0.0259	0.0256
Titanium Pm2.5 Lc	61	54	0.00462	0.00462	0.0035	0.0385	0.0166	0.0146
Total Nitrate Pm2.5 Lc	61	61	1.62	1.62	0.0393	12.3	7.23	5.74
Vanadium Pm2.5 Lc	61	20	0.000169	0.000619	0.00134	0.0018	0.00131	0.0011
Zinc Pm2.5 Lc	61	61	0.0667	0.0667	0.00317	0.475	0.3	0.297
Zirconium Pm2.5 Lc	61	35	0.00293	0.00293	0.0359	0.0183	0.0149	0.0105

Detroit, W Fort St. (N. Delray-SWHS) (261630015), Speciated $PM_{2.5}$ (µg/m³)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	61	47	0.271	0.271	0.0322	11.2	0.818	0.605
Ammonium Ion Pm2.5 Lc	61	61	0.653	0.653	0.00684	4.71	2.7	2.39
Antimony Pm2.5 Lc	61	32	0.00571	0.00571	0.0388	0.0282	0.026	0.0246
Arsenic Pm2.5 Lc	61	24	0.0000193	0.0000955	0.00186	0.00011	0.00011	0.00006
Barium Pm2.5 Lc	61	37	0.0111	0.0111	0.0801	0.0527	0.0505	0.0487
Bromine Pm2.5 Lc	61	24	0.000897	0.00227	0.00454	0.0103	0.00743	0.00569
Cadmium Pm2.5 Lc	61	34	0.00463	0.00463	0.0158	0.0245	0.0245	0.0231
Calcium Pm2.5 Lc	61	61	0.0983	0.0983	0.00887	0.458	0.325	0.229
Cerium Pm2.5 Lc	61	23	0.00585	0.00585	0.0954	0.0434	0.0433	0.0296
Cesium Pm2.5 Lc	61	30	0.007	0.007	0.0538	0.056	0.0334	0.0314
Chlorine Pm2.5 Lc	61	56	0.0427	0.0427	0.00433	0.369	0.216	0.204
Chromium Pm2.5 Lc	61	52	0.00158	0.00158	0.00276	0.0105	0.00644	0.00516
Cobalt Pm2.5 Lc	61	22	0.000365	0.000365	0.0033	0.00401	0.00365	0.00182
Copper Pm2.5 Lc	61	60	0.00819	0.00819	0.0114	0.0368	0.021	0.0197
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	60	60	0.712	0.712	0.0117	1.53	1.52	1.49
Indium Pm2.5 Lc	61	31	0.00456	0.00456	0.0381	0.0251	0.021	0.0192
Iron Pm2.5 Lc	61	61	0.173	0.173	0.0175	0.684	0.576	0.507
Lead Pm2.5 Lc	61	50	0.00595	0.00595	0.0122	0.0368	0.0301	0.0156
Magnesium Pm2.5 Lc	61	30	0.0277	0.0324	0.0463	0.427	0.128	0.107
Manganese Pm2.5 Lc	61	57	0.00513	0.00513	0.0064	0.0199	0.0147	0.0146
Nickel Pm2.5 Lc	61	48	0.000974	0.000974	0.00186	0.00592	0.00384	0.00349
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	60	60	3.13	3.13	0.348	8.95	6.08	5.15
Phosphorus Pm2.5 Lc	61	58	0.000317	0.000394	0.00257	0.00343	0.00242	0.00224
Potassium Ion Pm2.5 Lc	61	61	0.187	0.187	0.0606	2.49	2.24	1.26
Potassium Pm2.5 Lc	61	60	0.209	0.209	0.00627	2.67	2.36	1.23
Rubidium Pm2.5 Lc	61	29	0.000929	0.000929	0.00887	0.00498	0.00483	0.00457

Detroit, W Fort St. (N. Delray-SWHS) (261630015), Speciated $PM_{2.5}$ (µg/m³) - continued

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Selenium Pm2.5 Lc	61	40	0.00124	0.00124	0.00526	0.00511	0.00423	0.00421
Silicon Pm2.5 Lc	61	59	0.122	0.122	0.0177	2.32	0.399	0.312
Silver Pm2.5 Lc	61	34	0.00392	0.00392	0.0164	0.0212	0.0195	0.019
Sodium Ion Pm2.5 Lc	61	61	0.0432	0.0432	0.00885	0.209	0.197	0.161
Sodium Pm2.5 Lc	61	53	0.0549	0.0549	0.0916	0.192	0.162	0.15
Strontium Pm2.5 Lc	61	42	0.00142	0.00142	0.00722	0.00622	0.00509	0.00481
Sulfate Pm2.5 Lc	61	61	1.36	1.36	0.0218	3.78	3.28	3.1
Sulfur Pm2.5 Lc	61	61	0.47	0.47	0.00371	1.23	1.15	1.12
Tin Pm2.5 Lc	61	36	0.00434	0.00434	0.0488	0.0273	0.0262	0.0253
Titanium Pm2.5 Lc	61	58	0.0183	0.0183	0.0035	0.308	0.159	0.0535
Total Nitrate Pm2.5 Lc	61	61	1.85	1.85	0.0393	12	7.34	7.19
Vanadium Pm2.5 Lc	61	27	0.000621	0.000995	0.00134	0.0135	0.00402	0.00322
Zinc Pm2.5 Lc	61	61	0.0373	0.0373	0.00317	0.46	0.134	0.106
Zirconium Pm2.5 Lc	61	35	0.00385	0.00385	0.0359	0.0172	0.0158	0.0144

Grand Rapids-Monroe St. (260810020), Speciated $PM_{2.5}$ ($\mu g/m^3$)

Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Aluminum Pm2.5 Lc	121	66	0.0146	0.0146	0.0322	0.146	0.142	0.134
Ammonium Ion Pm2.5 Lc	121	120	0.686	0.686	0.00692	4.44	4.23	3.56
Antimony Pm2.5 Lc	121	69	0.00517	0.00517	0.0388	0.0333	0.0289	0.0256
Arsenic Pm2.5 Lc	121	56	0.0000193	0.000165	0.00186	0.00011	0.00011	0.00011
Barium Pm2.5 Lc	121	71	0.0111	0.0111	0.0801	0.132	0.0759	0.0643
Bromine Pm2.5 Lc	121	27	0.000379	0.00215	0.00454	0.00651	0.00518	0.00514
Cadmium Pm2.5 Lc	121	70	0.00465	0.00465	0.0158	0.0248	0.0246	0.0242
Calcium Pm2.5 Lc	121	121	0.0298	0.0298	0.00885	0.162	0.0926	0.0876
Cerium Pm2.5 Lc	121	61	0.0119	0.0119	0.0954	0.0644	0.0593	0.0583
Cesium Pm2.5 Lc	121	66	0.00867	0.00867	0.0538	0.0469	0.0468	0.0385
Chlorine Pm2.5 Lc	121	82	0.00583	0.00583	0.00432	0.153	0.0986	0.0344
Chromium Pm2.5 Lc	121	92	0.00461	0.00461	0.00276	0.191	0.0588	0.0335
Cobalt Pm2.5 Lc	121	37	0.000252	0.000252	0.0033	0.00341	0.00306	0.00247
Copper Pm2.5 Lc	121	98	0.00404	0.00404	0.0114	0.0533	0.0171	0.0167
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	116	116	0.366	0.366	0.0117	1.11	0.984	0.93
Indium Pm2.5 Lc	121	65	0.00447	0.00447	0.0381	0.0249	0.0201	0.0196
Iron Pm2.5 Lc	121	121	0.072	0.072	0.0176	0.609	0.498	0.285
Lead Pm2.5 Lc	121	85	0.00372	0.00372	0.0122	0.0165	0.0144	0.0142
Magnesium Pm2.5 Lc	121	74	0.0196	0.0227	0.0463	0.252	0.0729	0.0708
Manganese Pm2.5 Lc	121	97	0.00259	0.00259	0.0064	0.0229	0.0149	0.0123

Grand Rapids-Monroe St. (260810020), Speciated $PM_{2.5}$ (µg/m^3) - continued

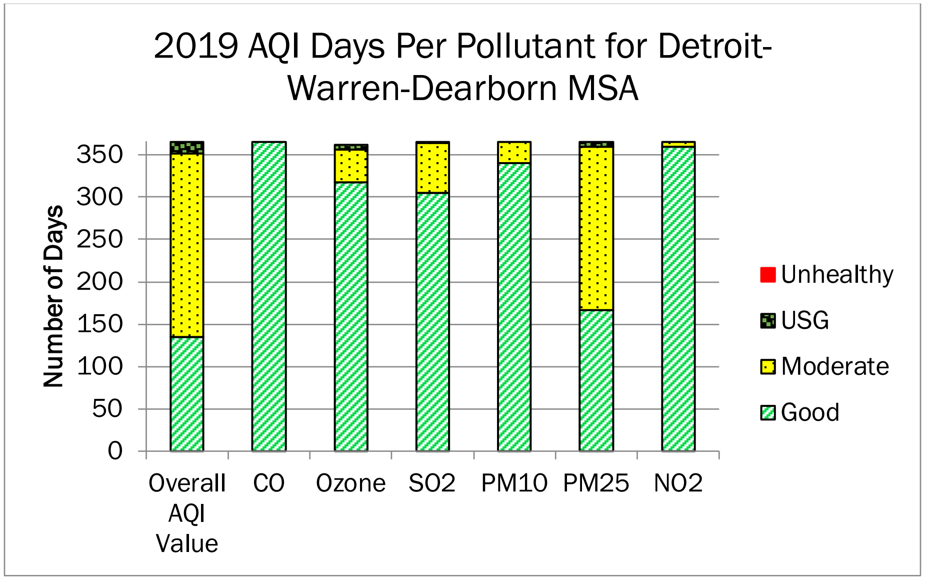
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Nickel Pm2.5 Lc	121	84	0.00126	0.00127	0.00186	0.0415	0.0144	0.00932
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	116	116	1.89	1.89	0.362	4.87	4.55	4.14
Phosphorus Pm2.5 Lc	121	113	0.00101	0.0011	0.00258	0.0931	0.00392	0.00356
Potassium Ion Pm2.5 Lc	121	120	0.0495	0.0495	0.0606	1.79	0.193	0.174
Potassium Pm2.5 Lc	121	121	0.0606	0.0606	0.00631	1.76	0.211	0.197
Rubidium Pm2.5 Lc	121	69	0.000863	0.000936	0.00888	0.00787	0.00704	0.00445
Selenium Pm2.5 Lc	121	73	0.000867	0.000867	0.00527	0.00477	0.00453	0.00418
Silicon Pm2.5 Lc	121	108	0.0322	0.0322	0.0175	0.272	0.186	0.163
Silver Pm2.5 Lc	121	60	0.00358	0.00358	0.0164	0.0246	0.0211	0.02
Sodium Ion Pm2.5 Lc	121	119	0.024	0.024	0.00882	0.171	0.148	0.146
Sodium Pm2.5 Lc	121	82	0.0414	0.0414	0.0917	0.182	0.173	0.169
Strontium Pm2.5 Lc	121	71	0.0013	0.0013	0.00723	0.0407	0.0177	0.00478
Sulfate Pm2.5 Lc	121	121	0.948	0.948	0.0217	3.19	3.09	2.44
Sulfur Pm2.5 Lc	121	121	0.329	0.329	0.00372	1.08	0.969	0.904
Tin Pm2.5 Lc	121	76	0.00613	0.00613	0.0489	0.0323	0.0303	0.0226
Titanium Pm2.5 Lc	121	99	0.00293	0.00295	0.00351	0.0155	0.0129	0.00926
Total Nitrate Pm2.5 Lc	121	121	1.99	1.99	0.0393	13.5	12.4	9.93
Vanadium Pm2.5 Lc	121	35	0.000131	0.000608	0.00134	0.00135	0.0013	0.00115
Zinc Pm2.5 Lc	121	121	0.0134	0.0134	0.00317	0.0434	0.04	0.04
Zirconium Pm2.5 Lc	121	70	0.00487	0.00487	0.0359	0.0213	0.0184	0.0182

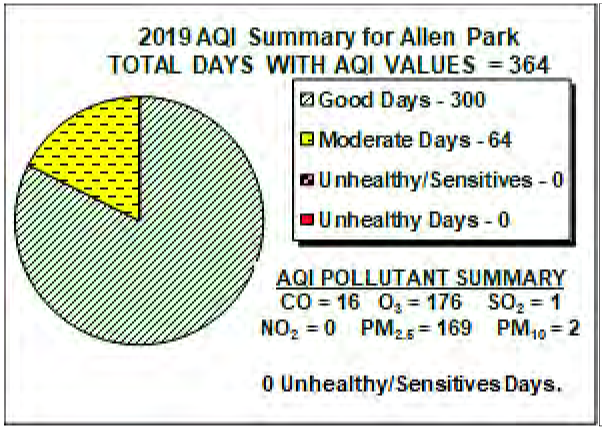
APPENDIX C: 2019 AIR QUALITY INDEX (AQI) PIE CHARTS

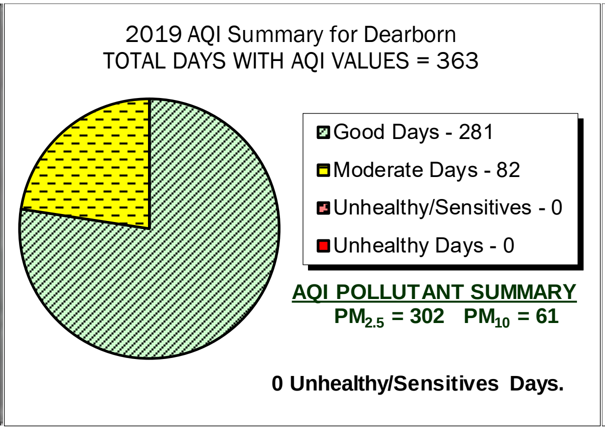
Appendix C contains pie charts that were created to show the AQI values for each of Michigan's 2019 monitoring sites and includes the total number of days measurements were taken, along with the pollutant distribution of the AQI values for those measurements. It is important to note that not all pollutants are measured at each site. In fact, some sites only obtain AQI measurements for that portion of the year corresponding to the ozone season; therefore, the number of days for each site may not be equivalent to 365. **Figures C.1** through **C.7** are grouped by Metropolitan Statistical Area (MSA). MSAs are geographic regions based on population and employment data that the US Census compiles. They are defined by the US Office of Management and Budget. More information on MSAs can be found on the US Census website: www.census.gov. **Figures C.8** and **C.9** show the remaining sites (not part of a CSA) located in Michigan's Upper and Lower Peninsulas, respectively.

See Legend for Appendix C Pie Charts

Figure C.1: AQI Summaries for Detroit-Warren-Dearborn MSA







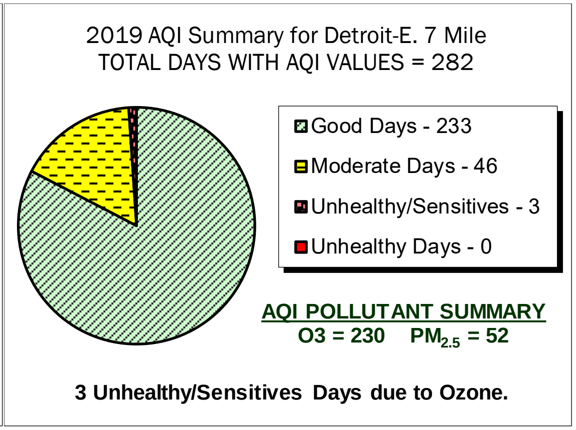
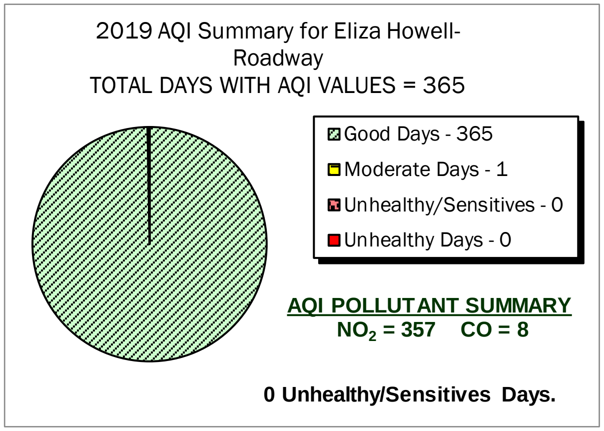
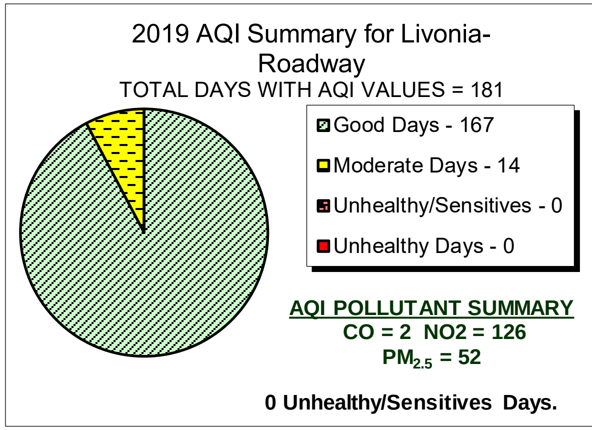
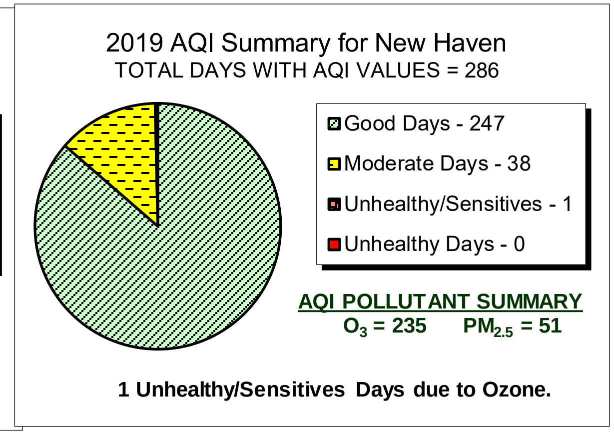
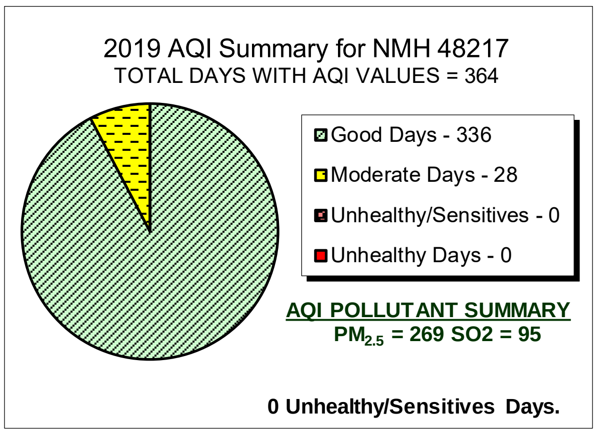


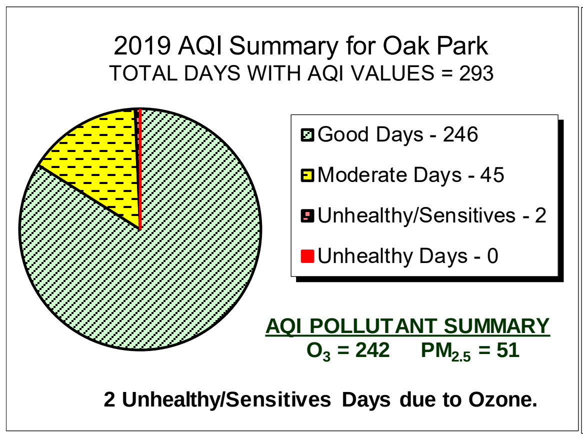
Figure C1, continued: AQI Summaries for Detroit-Warren-Dearborn-MSA











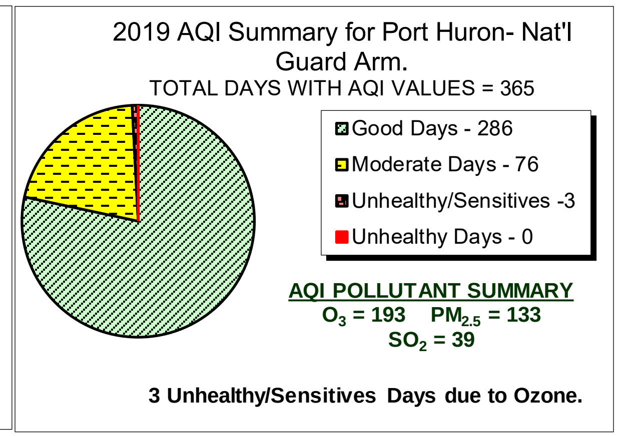


Figure C1, continued: AQI Summaries for Detroit-Warren-Dearborn-MSA

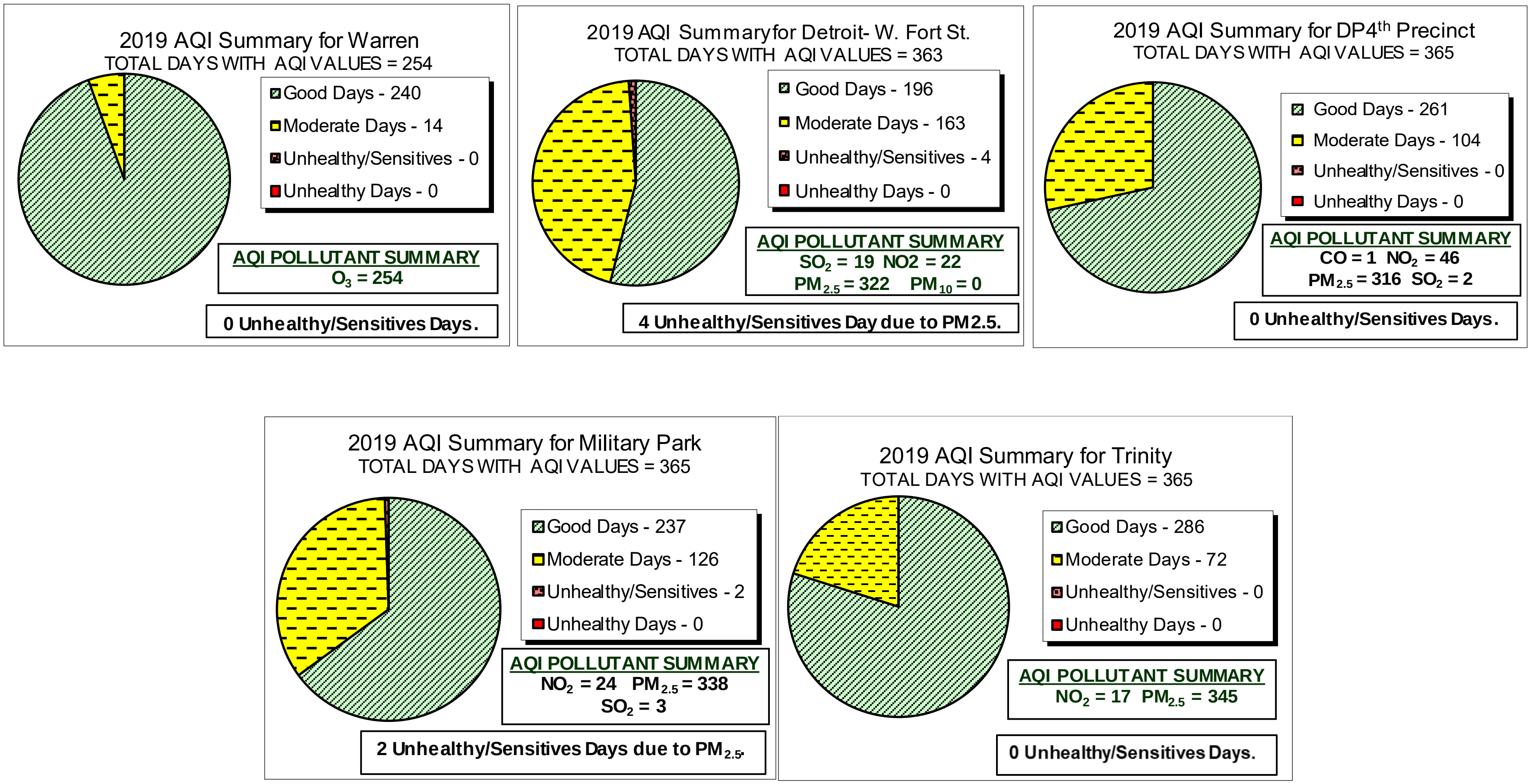
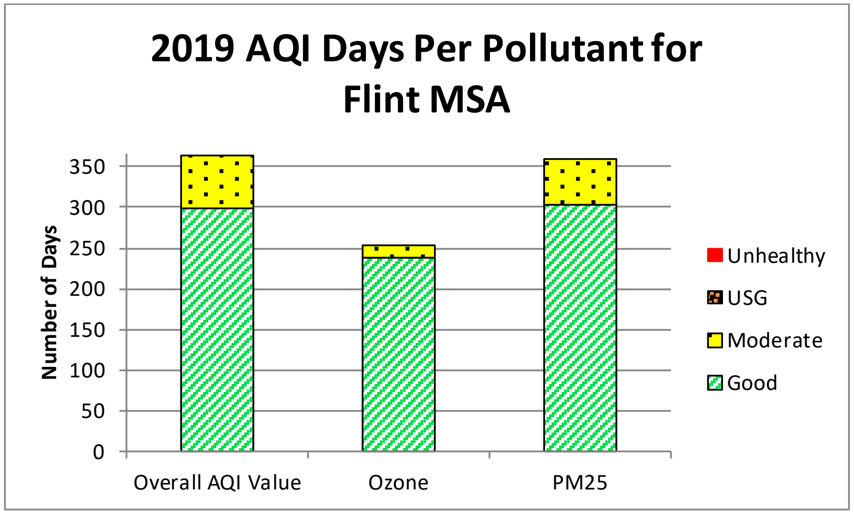
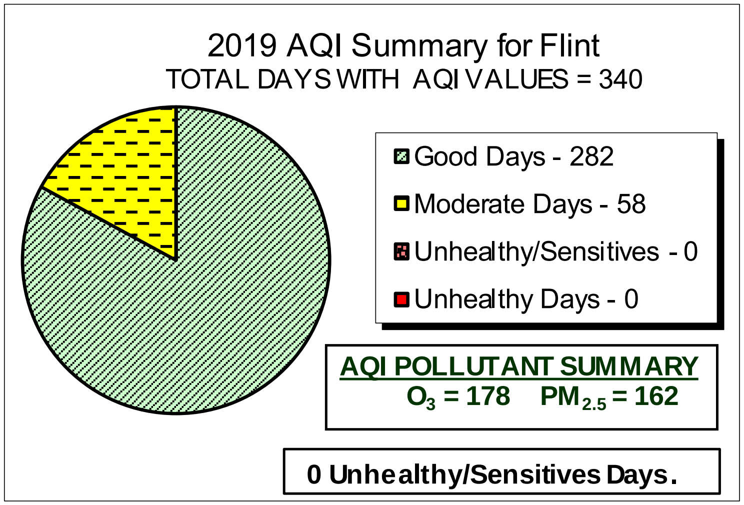


Figure C2: AQI Summaries for Flint MSA





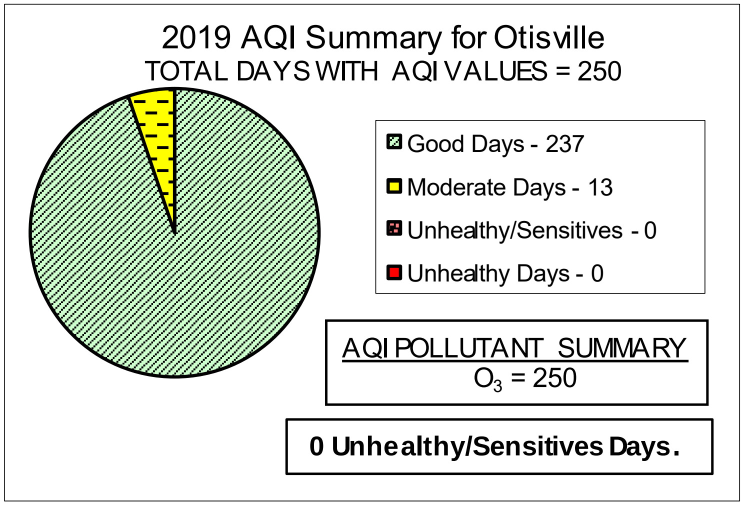
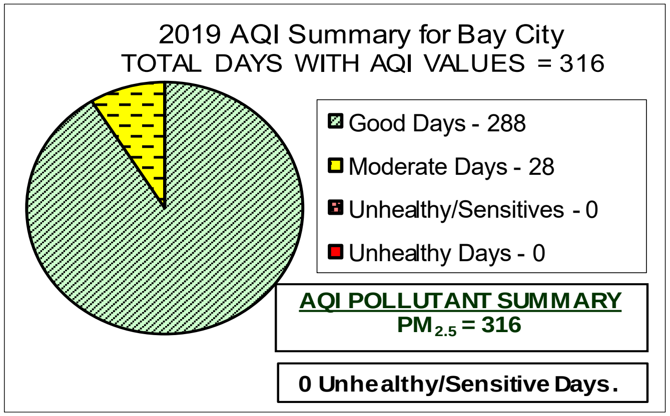
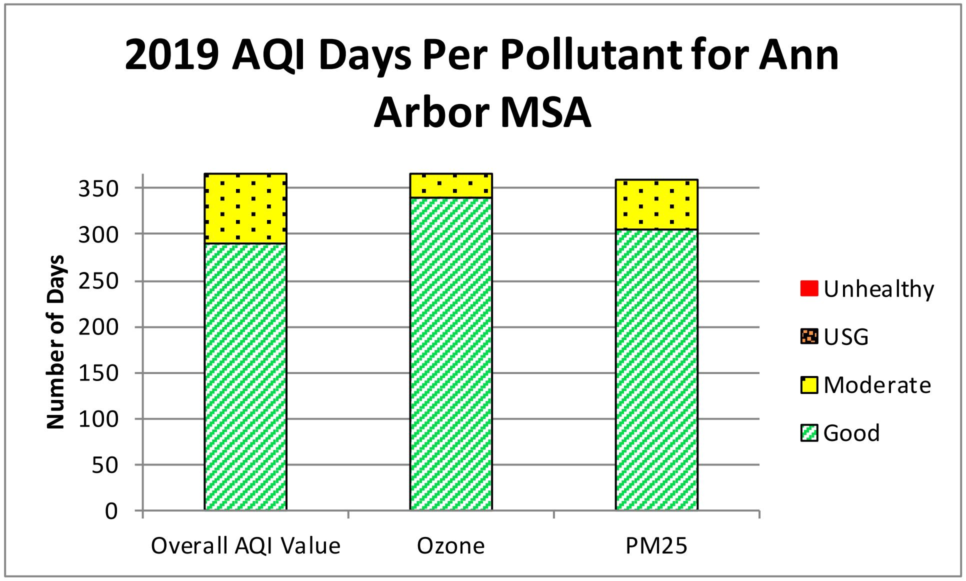


Figure C3: AQI Summary for Saginaw-Midland-Bay City-MSA



*Note: This site does not have AQI per pollutant graphs since only one pollutant is monitored in one location in these areas.

Figure C4: Ann Arbor MSA



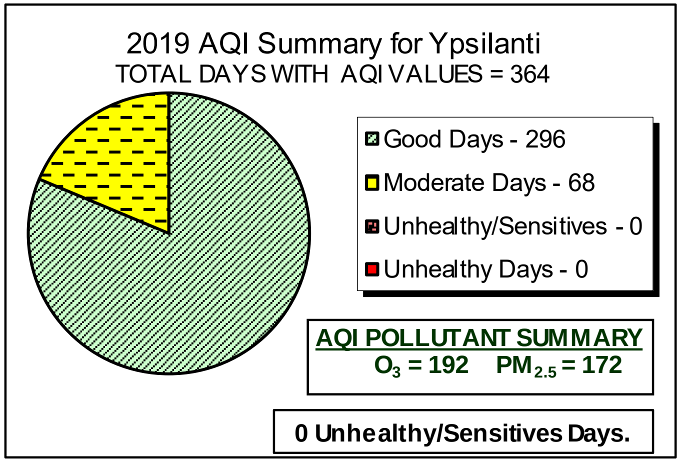
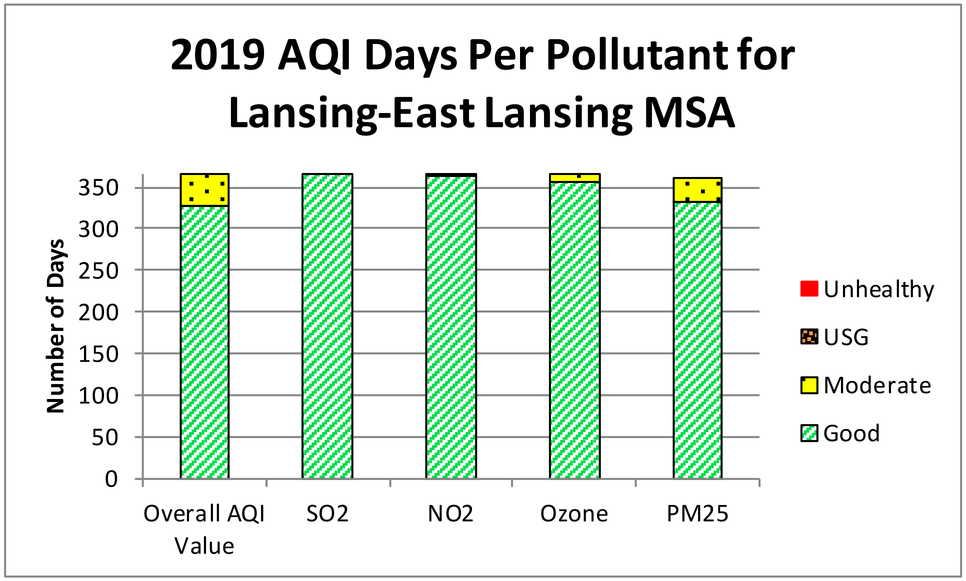
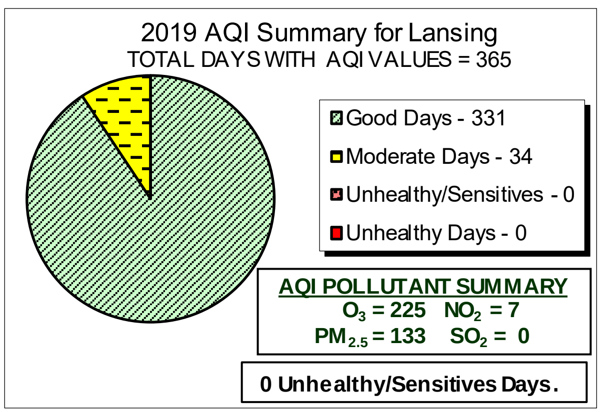


Figure C5: AQI Summaries for Lansing-East Lansing-MSA





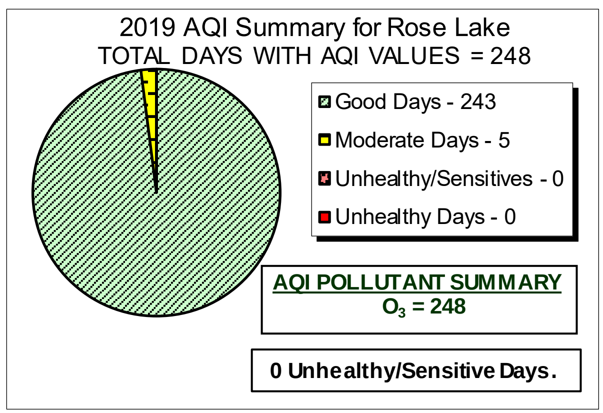
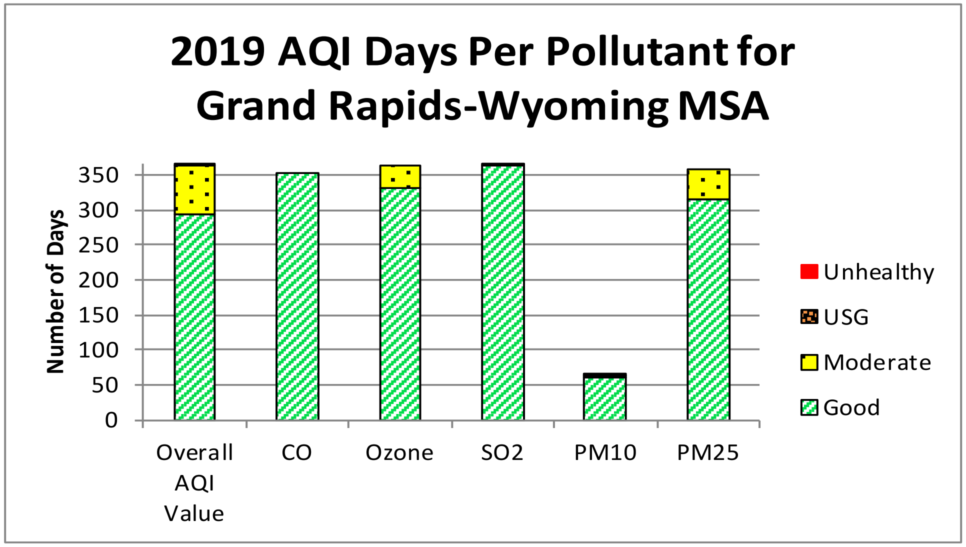
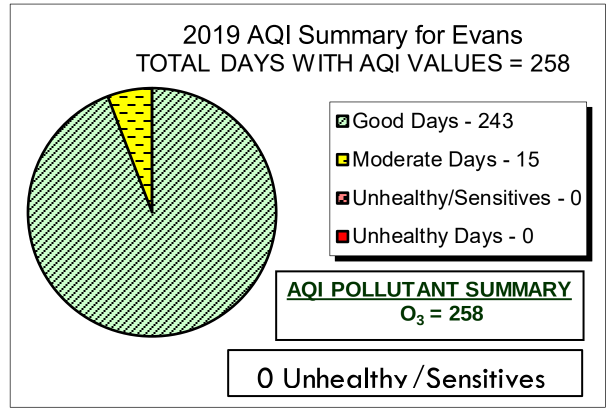
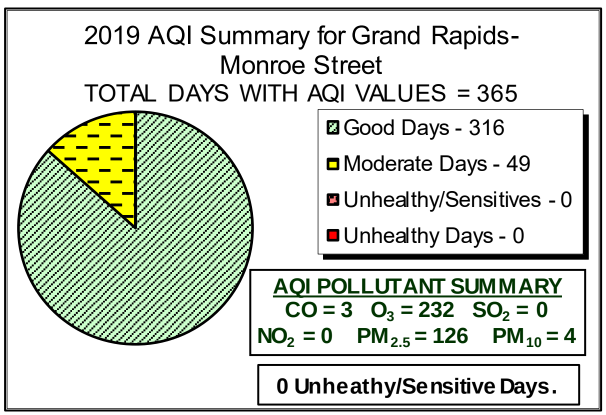
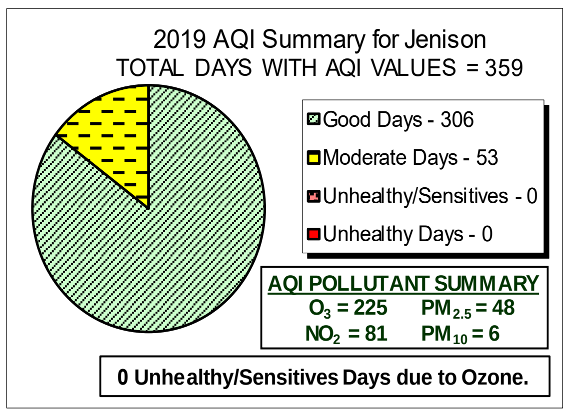


Figure C6: AQI Summaries for Grand Rapids-Wyoming MSA









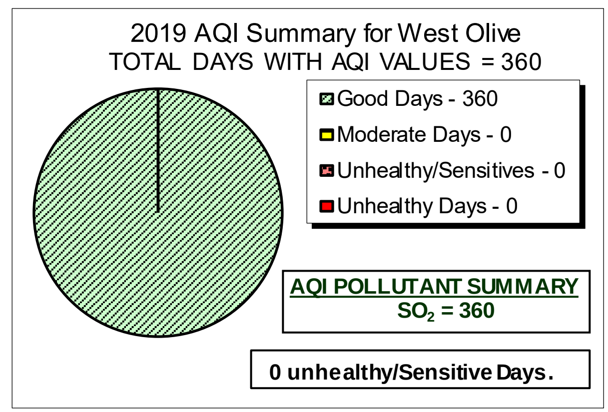
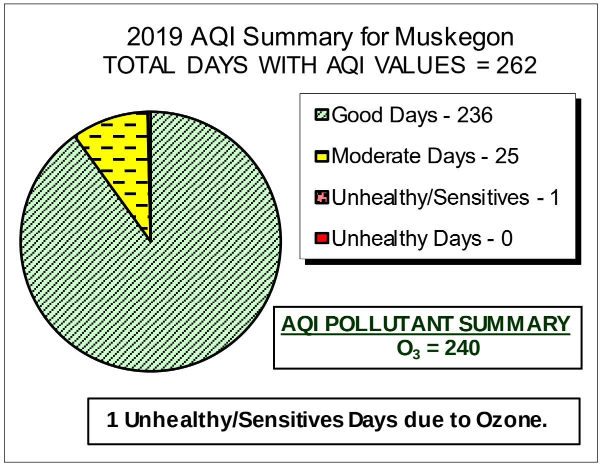
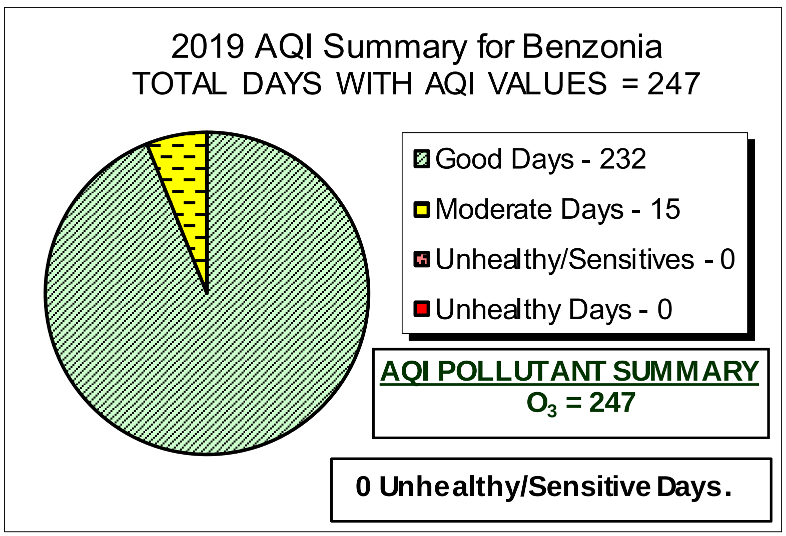


Figure C7: Muskegon MSA



*Note: This site does not have AQI per pollutant graphs since only one pollutant is monitored in one location in these areas.

Figure C8: AQI Summaries for Michigan's Other Lower Peninsula Areas



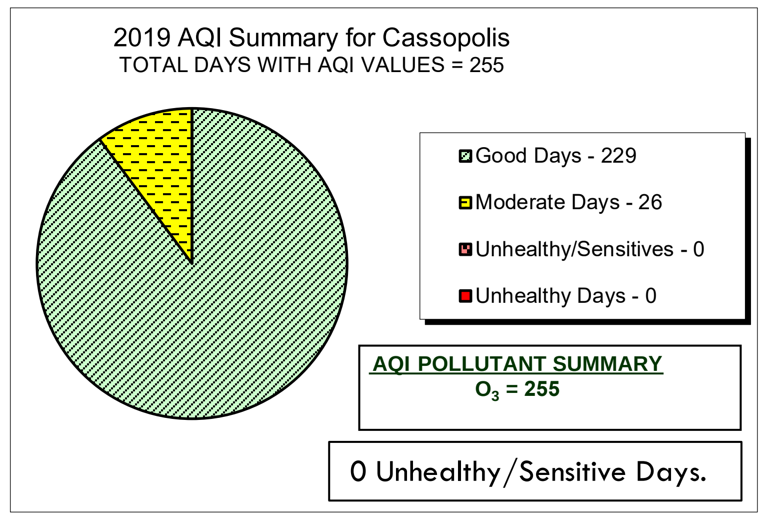
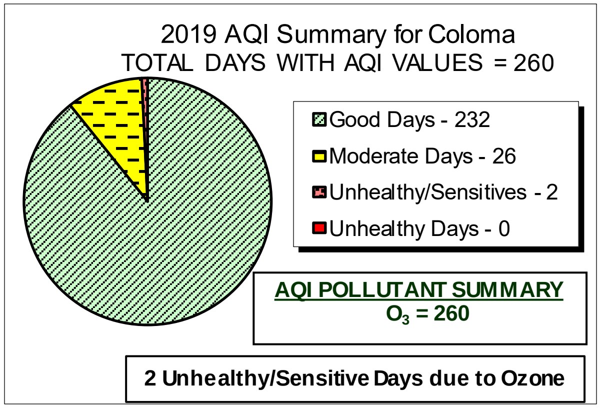
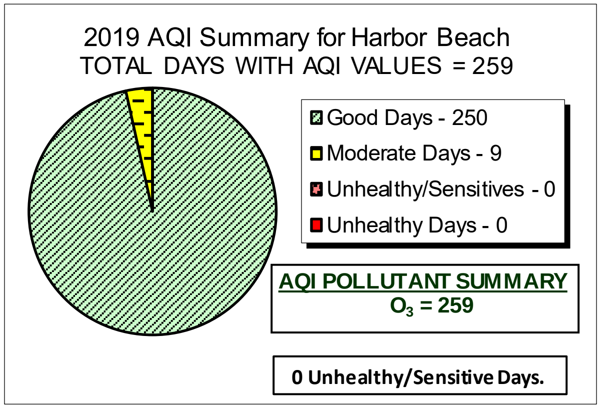


Figure C8, continued: AQI Summaries for Michigan's Other Lower Peninsula Areas





- Note: These sites do not have AQI per pollutant graphs since only one pollutant is monitored in one location in these areas.

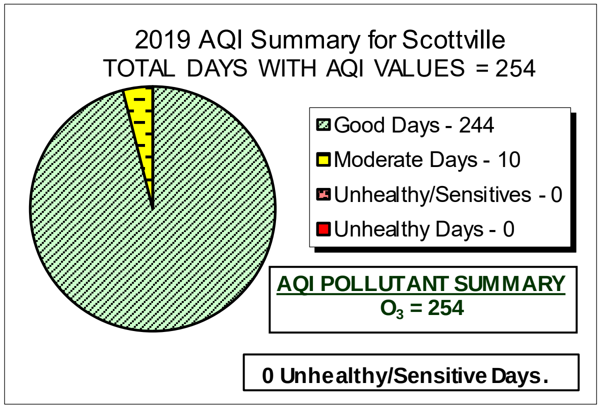
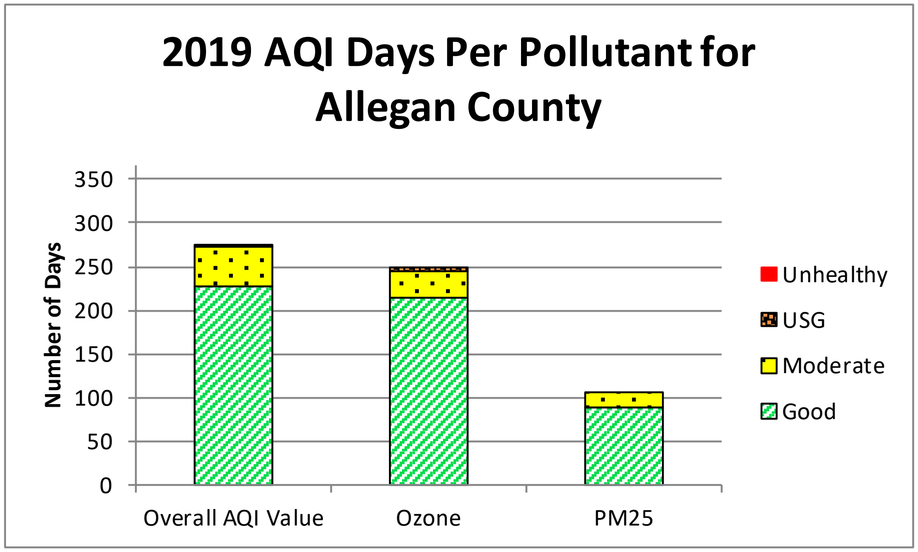
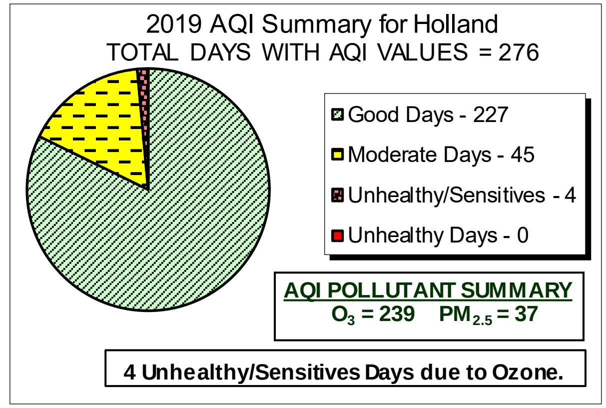
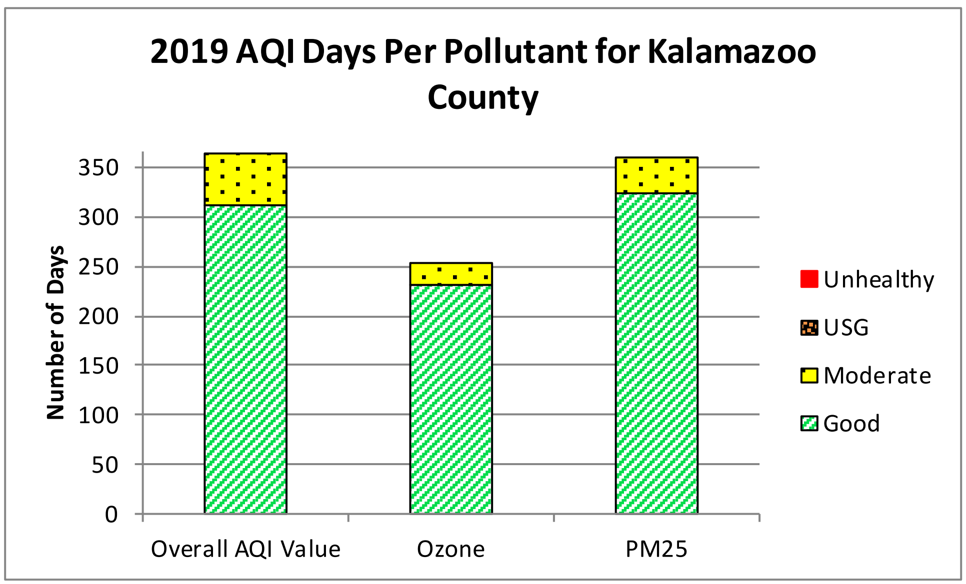


Figure C8, continued: AQI Summaries for Michigan's Other Lower Peninsula Areas







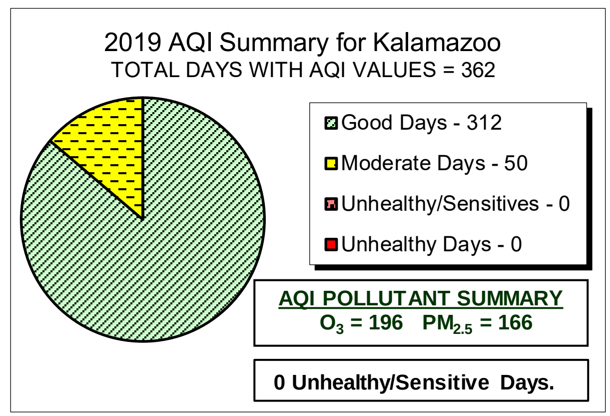
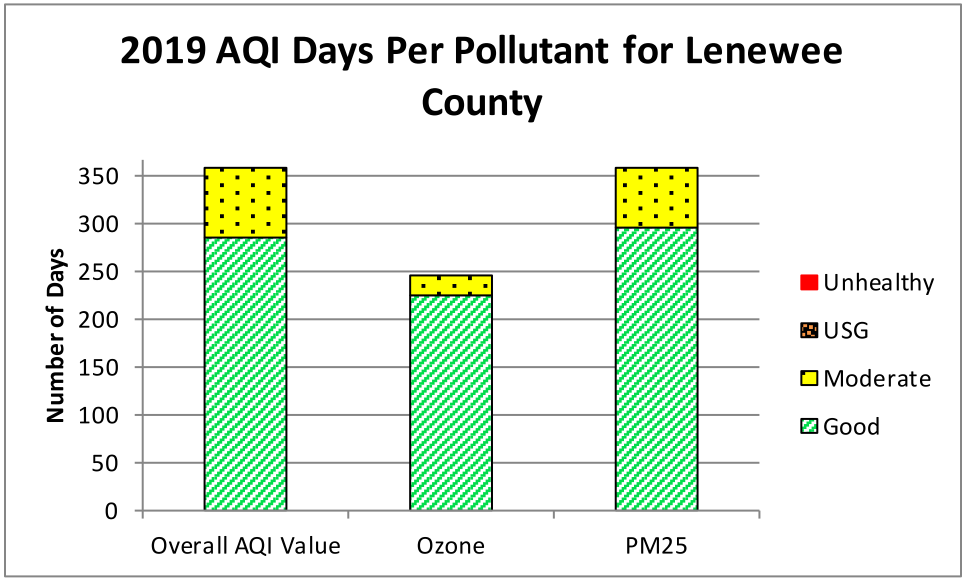
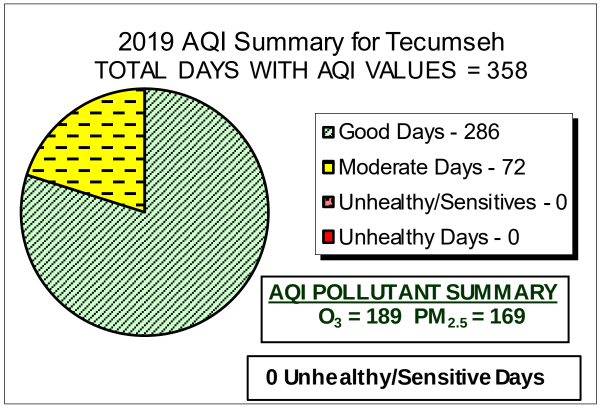
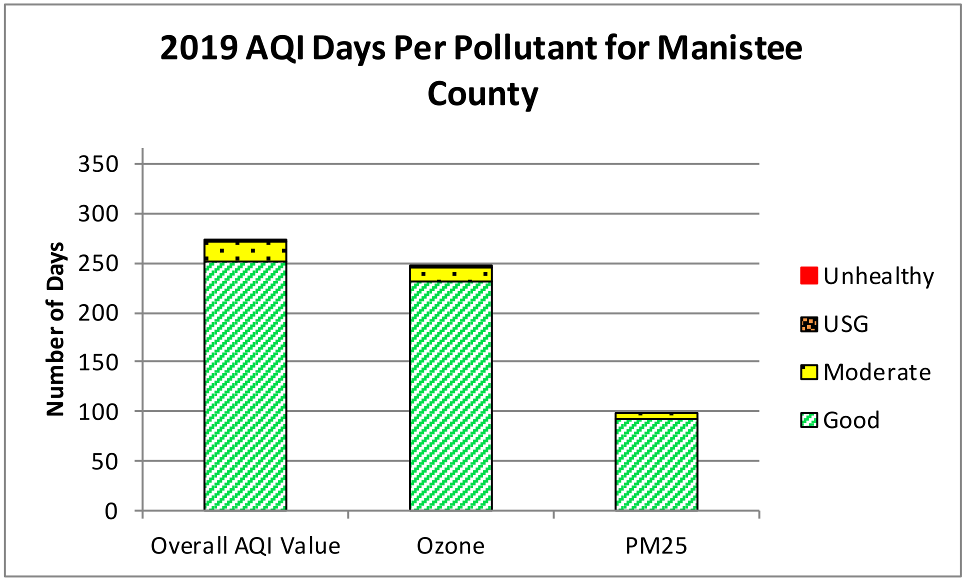


Figure C8, continued: AQI Summaries for Michigan's Other Lower Peninsula Areas


2019 AQI Days Per Pollutant for Lenewee County
Number of Days
350
300
250
200
150
100
50
0
Overall AQI Value
Ozone
PM25
Unhealthy
USG
Moderate
Good


2019 AQI Summary for Tecumseh
TOTAL DAYS WITH AQI VALUES = 358
Good Days - 286
Moderate Days - 72
Unhealthy/Sensitives - 0
Unhealthy Days - 0
AQI POLLUTANT SUMMARY
O_3 = 189 $PM_{2.5}$ = 169
0 Unhealthy/Sensitive Days


2019 AQI Days Per Pollutant for Manistee County
Number of Days
350
300
250
200
150
100
50
0
Overall AQI Value
Ozone
PM25
Unhealthy
USG
Moderate
Good

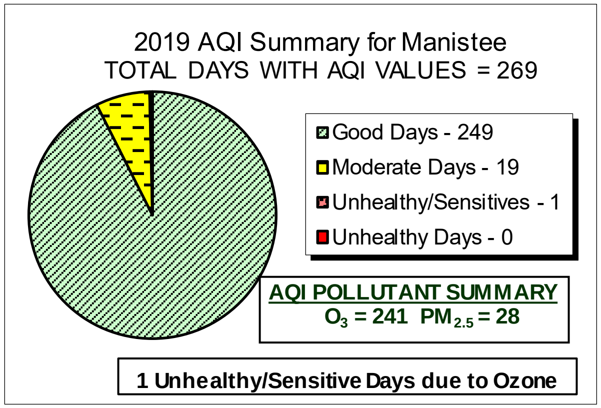
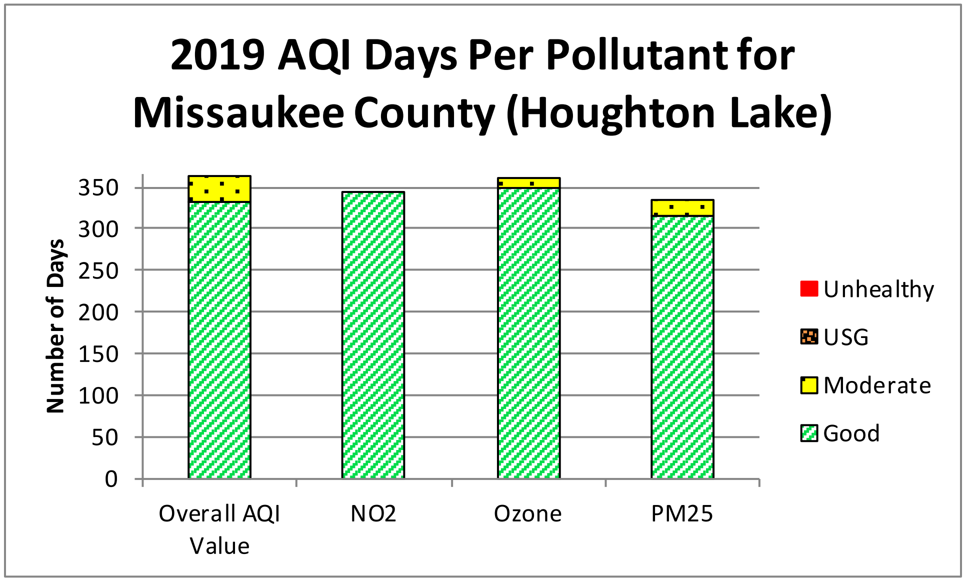
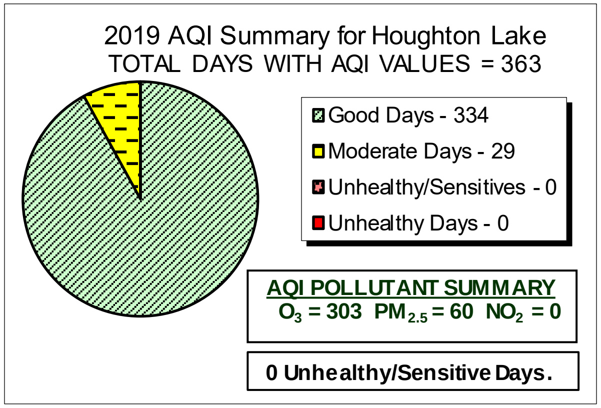
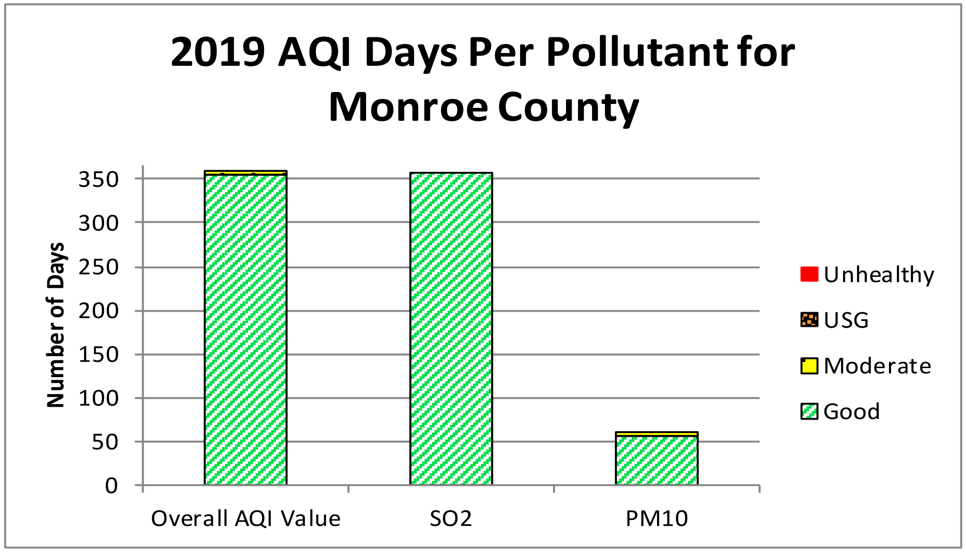

2019 AQI Summary for Manistee
TOTAL DAYS WITH AQI VALUES = 269
Good Days - 249
Moderate Days - 19
Unhealthy/Sensitives - 1
Unhealthy Days - 0
AQI POLLUTANT SUMMARY
O_3 = 241 $PM_{2.5}$ = 28
1 Unhealthy/Sensitive Days due to Ozone

Figure C8, continued: AQI Summaries for Michigan's Other Lower Peninsula Areas







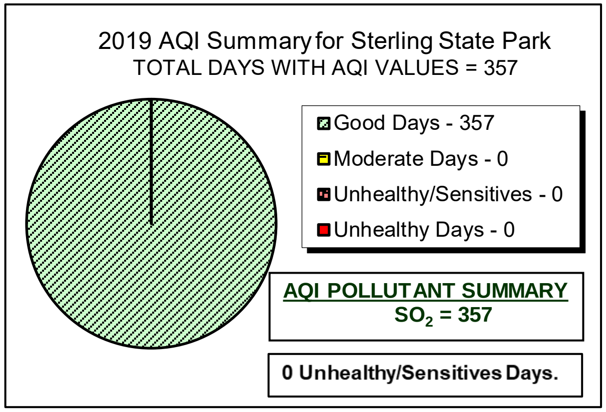
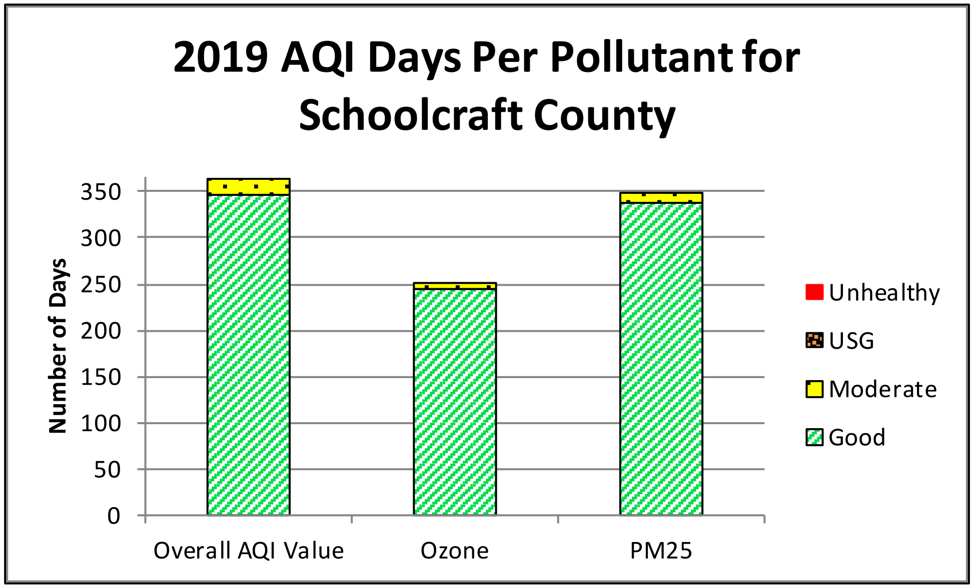
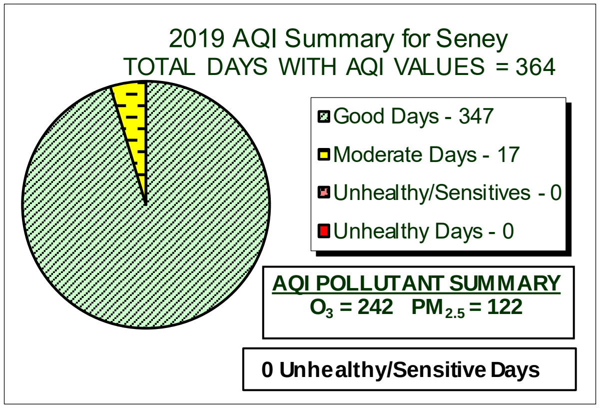


Figure C9: AQI Summary for Upper Peninsula





APPENDIX D - SUMMARY

Appendix D summarizes the development of the NAAQS and how compliance with these standards is determined. Also included is the variety of monitoring techniques, requirements used to ensure quality data is obtained, and a history of NAAQS changes that have occurred since the inceptions of the CAA.

National Ambient Air Quality Standards (NAAQS)

Under Section 109 of the CAA, the USEPA established a primary and secondary NAAQS for each pollutant for which air quality criteria have been issued. The primary standard is designed to protect the public health with an adequate margin of safety, including the health of the most susceptible individuals in a population, such as children, the elderly, and those with chronic respiratory ailments. Factors in selecting the margin of safety for the primary standard include the nature and severity of the health effects involved and the size of the sensitive population at risk. Secondary standards are chosen to protect public welfare (personal comfort and well-being) and the environment by limiting economic damage, impacts on visibility and climate, and harmful effects on soil, water, crops, vegetation, wildlife, and buildings.

In addition, the NAAQS have various averaging times to address health impacts. Short averaging times reflect the potential for acute (immediate) effects, whereas long-term averaging times are designed to protect against chronic (long-term) effects.

NAAQS have been established for CO, Pb, NO_2, PM, O_3, and SO_2. **Table 1.1** lists the primary and secondary NAAQS, averaging time and concentration level for each criteria pollutant in effect in 2018. The concentrations are listed as parts per million (ppm), micrograms per cubic meter ($\mu g/m^3$), and/or milligrams per cubic meter (mg/m^3).

Table D1.1: NAAQS in Effect during 2019 for Criteria Pollutants

Pollutant	Primary (health) Level	Primary Averaging Time	Secondary (welfare) Level	Secondary Averaging Time
Carbon Monoxide (CO) 8-hour average	9 ppm (10 mg/m^3)	8-hour average, not to be exceeded more than once per year *(1971)*	None*	None*
Carbon Monoxide (CO) 1-hour average	35 ppm (40 mg/m^3)	1-hour average, not to be exceeded more than once per year *(1971)*	None*	None*
Lead (Pb)	0.15 µg/m^3	Maximum rolling 3-month average *(2008)*	Same as Primary	Same as Primary
Nitrogen Dioxide (NO_2) Annual mean	0.053 ppm (100 µg/m^3)	Annual mean *(1971)*	Same as Primary	Same as Primary
Nitrogen Dioxide (NO_2) 1-hour average	0.100 ppm	98th percentile of 1-hour average, averaged over 3 years *(2010)*	Same as Annual	Same as Annual
Particulate Matter (PM_{10})	150 µg/m^3	24-hour average, not to be exceeded more than once per year over 3 years *(1987)*	Same as Primary	Same as Primary
Particulate Matter ($PM_{2.5}$) Annual average	12.0 µg/m^3	Annual mean averaged over 3 years *(2012)*	15.0 µg/m^3	Annual mean
Particulate Matter ($PM_{2.5}$) 24-hour average	35 µg/m^3	98th percentile of 24-hour concentration, averaged over 3 years *(2006)*	Same as Primary	Same as Primary
Ozone (O_3)	0.070 ppm	Annual 4th highest 8-hour daily max averaged over 3 years *(2015)*	Same as Primary	Same as Primary
Sulfur Dioxide (SO_2)	0.075 ppm	99th percentile of 1-hour daily max averaged over 3 years *(2010)*	0.5 ppm	3 hours

*In 1985, the USEPA revoked the secondary standard for CO (for public welfare) due to a lack of evidence of adverse effects on public welfare at or near ambient concentrations.

To demonstrate compliance with the NAAQS, the USEPA has defined specific criteria for each pollutant, which are summarized in **Table D1.2.**

Table D1.2: Criteria for the Determination of Compliance with the NAAQS

Pollutant	Criteria for Compliance
CO	Compliance with the CO standard is met when the second highest, non-overlapping, 35 ppm, 1-hour average standard and/or the 9 ppm, 8-hour average standard is not exceeded more than once per year.
Pb	Compliance with the Pb standard is met when daily values collected for three consecutive months are averaged and do not exceed the 0.15 µg/m^3 standard.
NO_2	Compliance is met when the annual arithmetic mean concentration does not exceed the 0.053 ppm standard and the 98th percentile* of the daily maximum 1-hour concentration averaged over 3 years does not exceed 100 ppb.
PM_{10}	The 24-hour PM_{10} primary and secondary standards are met when 150 µg/m^3 is not exceeded more than once per year on average over 3 years.
$PM_{2.5}$	The annual $PM_{2.5}$ primary and secondary standards are met when the annual arithmetic mean concentration is less than or equal to 12 µg/m^3 and 15 µg/m^3, respectively. The 24-hour $PM_{2.5}$ primary and secondary standards are met when the 3-year average of the 98th percentile** 24-hour concentration is less than or equal to 35 µg/m^3.
O_3	The 8-hour O_3 primary and secondary standards are met when the 3-year average of the 4th highest daily maximum 8-hour average concentration is less than or equal to 0.070 ppm.
SO_2	To determine compliance, the 99th percentile*** 1-hour concentration averaged over a 3-year period does not exceed 0.075 ppm, and the 3-hour average concentration shall not exceed 0.5 ppm more than once per calendar year.

**98th percentile daily maximum 1-hour value* is the value below which nominally 98 percent of all daily maximum 1-hour concentration values fall, using the ranking and selection method specified in section 5.2 of appendix S of CFR Part 50.

** *98th percentile* is the daily value out of a year of $PM_{2.5}$ monitoring data below which 98 percent of all daily values fall using the ranking and selection method specified in section 4.5(a) of appendix N of CFR Part 50.

*** *99th percentile daily maximum 1-hour value* is the value below which nominally 99 percent of all daily maximum 1-hour concentration values fall, using the ranking and selection method specified in section 5 of appendix T of CFR Part 50.

As part of the USEPA's grant to EGLE, the AQD provides an annual Network Review document[13] of all monitoring data collected from the previous year and recommendations on any network changes. These recommendations are based on each monitor's exceedance history, changes in population distribution, and modifications to federal monitoring requirements under the CAA. Under the amended air monitoring regulations that began in 2007, states are required to solicit public comment (in May of each year) on their future air monitoring network design prior to submitting the annual review to the USEPA in July.

[13] Most recent Network Reviews

Types of Monitors

Federal Reference Method (FRM): method of sampling and analyzing the ambient air for an air pollutant that USEPA uses as the "gold standard" for measuring that pollutant. FRM monitors are used to designate attainment/nonattainment areas. The gaseous pollutants CO, NO_2, O_3, and SO_2 are measured with continuous FRM monitors that provide real-time hourly data. The FRM for PM and Pb requires a filter that measure concentrations over a 24-hour period. These filters must be further analyzed in a laboratory; therefore, the samples results are delayed.

Rural background monitors: measure background air quality in non-urban areas

Aethalometers: measure carbon black, a combustion by-product typical of transportation sources, by concentrating particulate on a filter tape and measuring changes in optical transmissivity and absorption.

EC/OC instruments measure elemental carbon using pyrolysis coupled with a nondispersive infrared detector to separate the elemental and organic carbon fractions.

Federal Equivalent Method (FEM): method for measuring the concentration of an air pollutant in the ambient air that has been designated as equivalent to the FRM.

Continuous Monitors: measure data in real-time, meaning concentrations of the air pollutant are usually available within an hour on the MIair website.

TEOM: tapered element oscillating monitors (TEOMs) are continuous PM monitor that is used only for real-time data indications since they are not FEMs and cannot be used for attainment/nonattainment designations.

BAM: Beta attenuation monitors (BAMs) are real-time, continuous PM2.5 monitor that is FEM, thus can be used for attainment/nonattainment designation.

$PM_{2.5}$ FRM Monitoring: The concentrations of $PM_{2.5}$ measured over a 24-hour time period are determined using the filter-based gravimetric FRM. Data generated by the FRM monitors are used for comparisons to the NAAQS in Michigan. The sites are located in urban, commercial, and residential areas where people are exposed to $PM_{2.5}$.

Chemical Speciation Monitoring: Speciated monitoring provides a better understanding of the chemical composition of $PM_{2.5}$ material and better characterizes background levels. Single event Met-One Speciation Air Sampling System (SASS) monitors are used throughout Michigan's speciation network

National Air Toxics Trend Station (NATTS): Network developed to fulfill the need for long-term hazardous air pollutants (HAPs) monitoring data of consistent quality. Among the principle objectives are assessing trends and emission reduction program effectiveness, assessing and verifying air quality models.

NCore Network: began January 1, 2011, as part of the USEPA's 2006 amended air monitoring requirements. National Core (NCore) sites provide a full suite of measurements at one location. NCore stations collect the following measurements: ozone, SO2 (trace), CO (trace), NOY (reactive oxides of nitrogen), PM2.5 FRM, continuous PM2.5, speciated PM2.5, wind speed, wind direction, relative humidity, and ambient temperature. In addition, filter-based measurements are required for PM coarse (PM10-2.5) on a once every three-day sampling frequency. This information will support scientific studies ranging across technological, health, and atmospheric process disciplines. Michigan has two NCore sites; Allen Park and Grand Rapids-Monroe Street.

Near-road Monitoring Network: focuses on vehicle emissions and how they disperse near-roadways, was approved by USEPA in 2011. This network, now referred to as the near-roadway network, is focused on high traffic urban roads in Core-Based Statistical Areas (CBSAs) with more than one million people. In 2011 Michigan took over the USEPA's pre-existing near-roadway site at Eliza Howell Park in Detroit. A second near-road site was added in Livonia in January 2015.

Population-Oriented Monitors: monitors that are located in an area where many people live, also considered ambient air.

Transport monitors: measure air pollutants that that have travelled a distance from the emission sources and are formed in the atmosphere when certain pollutants are present, like ozone.

Source-Oriented/Point-Source Monitors: monitors that are located near a specific emissions source (e.g., factory) of a pollutant.

Primary Monitor: data from these monitors are used to compare to the NAAQS and must meet quality assurance criteria.

Secondary/Precision/Co-located Monitor: two or more air samplers, analyzers, or other instruments that are operated simultaneously while located side by side. These are used for quality assurance purposes.

Urban Scale Monitors: measures air pollution concentrations in more populated urban areas.

Quality Assurance

The AQD's Air Monitoring Unit (AMU) ensures that all data collected and reported is of high quality and meets federal requirements. The AMU has a quality system in place that includes a Quality Assurance Project Plan (QAPP), standard operating procedures (SOPs), standardized forms and documentation policies, and a robust audit and assessment program.

The monitoring network adheres to the requirements in Title 40 of the Code of Federal Regulations (CFR), Parts 50, 53, and 58. This ensures that the monitors are correctly sited, operated in accordance to the federal reference methods, and adhere to the quality assurance requirements.

Quality assurance checks are conducted by site operators at the frequencies required in the regulations and unit procedures. Independent audits are conducted by the AMU's Quality Assurance (QA) Team, which has a separate reporting line of supervision. The quality assurance checks and audits are reported to the USEPA each quarter.

External audits are conducted annually by the USEPA. The USEPA conducts Performance Evaluation Program (PEP) audits for $PM_{2.5}$ samplers and the National Performance Audit Program (NPAP) checks for the gaseous monitors. The USEPA also conducts program-wide Technical Systems Audits (TSAs) every three years to evaluate overall program operations and assess adequacy of documentation and records retention. External audits are also conducted on the laboratory operations for certain analytical techniques using performance evaluation samples.

Historical NAAQS Changes

1971

CO: 1-hour maximum not to exceed 35 ppm more than once in a year / 8-hour maximum not to exceed 9 ppm more than once in a year.

NO_2: Annual average of 553 ppb or less

SO_2: 24-Hour concentration of 0.14 ppm not exceeded more than once per year / Annual average of 0.03 ppm or less.

Ozone: Total photochemical oxidants: 1-hour max of 0.08 ppm not exceeded once per yr

TSP: 24-hour average not to exceed 260 µg/m^3 more than once per yr / Annual geometric mean of 75 µg/m^3

1978

Lead: Calendar quarter average of 1.5 µg/m^3 not to be exceeded

1979

Ozone: 1-hour maximum concentration is 0.12 ppm one or less hour per yr

1987

PM_{10}: 24-hour average not to exceed 150 µg/m^3 more than once per yr on average over a 3-yr period / Annual mean of 50 µg/m^3 or less average over 3 yrs

1997

Ozone: 4th highest daily maximum 8-hour concentration averaged over 3 yrs is 0.08 ppm or less

$PM_{2.5}$: Annual mean of 15.0 µg/m^3 or less average over 3 yrs / 98th percentile of 24-hour average of 65 µg/m^3 or less averaged over 3 yrs

2006

TSP & PM_{10}: Annual average revoked / 24-hour average retained

$PM_{2.5}$: Annual mean retained / 98th percentile of 24-hour average of 35 µg/m^3 or less averaged over 3 yrs

2008

Lead: 3-month average of 0.15 µg/m^3 not to be exceeded

Ozone: 4th highest daily maximum 8-hour concentration averaged over 3 yrs is 0.075 ppm or less

2010

NO_2: 98th percentile of the 1-hour concentration averaged over 3 yrs is 100 ppb or less

SO_2: 1-hour average of 99th percentile is 75 ppb or less, averaged over 3 yrs. Previous revoked

2012

$PM_{2.5}$: Annual mean of 12.0 µg/m^3 or less average over 3 yrs.

2015

Ozone: 4th highest daily maximum 8-hour concentration averaged over 3 yrs is 0.070 ppm or less

APPENDIX E: ACRONYMS AND THEIR DEFINITIONS

> .... Greater than
< .... Less than
≥ .... Greater than or equal to
≤ .... Less than or equal to
%........................ Percent
µg/m^3 .... Micrograms per cubic meter
µm...................... Micrometer
AIRS ID............. Aerometric Information Retrieval System Identification Number
AMU .... Air Monitoring Unit
AQD .... Air Quality Division
AQES................. Air Quality Evaluation Section
AQI.................... Air Quality Index
AQS................... Air Quality System (EPA air monitoring data archive)
As....................... Arsenic
BAM................... Beta Attenuation Monitor (hourly $PM_{2.5}$ measurement monitor)
BC .... Black Carbon
BTEX .... Benzene, Toluene, Ethylbenzene and Xylene
CAA................... Clean Air Act
CBSA................. Core-Based Statistical Area
Cd .... Cadmium
CFR .... Code of Federal Regulations
CO .... Carbon monoxide
CSA .... Consolidated Statistical Area
EC/OC.............. Elemental carbon/Organic carbon
EGLE.................. Michigan Department of Environment, Great Lakes and Energy
FDMS................. Filter Dynamic Measurement System
FEM.................... Federal Equivalent Method
FIA...................... Family Independence Agency
FR .... Federal Register
FRM .... Federal Reference Method
GHB................... Gordie Howe International Bridges
HAP .... Hazardous Air Pollutant
hr .... Hour
Lc........................ Local Conditions

MASN .... Michigan Air Sampling Network
MDL .... Method Detection Limit
mg/m^3 .... Milligrams per meter cubed
MI .... Michigan
MiSA .... Micropolitan Statistical Area
Mn .... Manganese
MSA .... Metropolitan Statistical Area
NAAQS .... National Ambient Air Quality Standard
NAMS .... National Air Monitoring Station
NATTS .... National Air Toxics Trend Sites
NCore .... National Core Monitoring Sites
ND .... Non-detect
NEI .... National Emission Inventory
Ni .... Nickel
NMH 48217 ... New Mount Hermon 48217 ZIP code monitoring site
NO .... Nitric Oxide
NO_2 .... Nitrogen Dioxide
NO_X .... Oxides of Nitrogen
NO_Y .... Oxides of Nitrogen + nitric acid + organic and inorganic nitrates
NPAP .... National Performance Audit Program
O_3 .... Ozone
Obs/OBS .... Observations
PAMS .... Photochemical Assessment Monitoring Station
PAH .... Polynuclear Aromatic Hydrocarbon
Pb .... Lead
PBT .... Persistent, Bioaccumulative and Toxic
PCB .... Polychlorinated Biphenyls
PEP .... Performance Evaluation Program
PM .... Particulate Matter
$PM_{2.5}$ .... Particulate Matter with an aerodynamic diameter less than or equal to 2.5 microns
PM_{10} .... Particulate Matter with a diameter of 10 microns or less
$PM_{10-2.5}$ .... Coarse PM equal to the concentration difference between PM_{10} and $PM_{2.5}$
PNA .... Polynuclear Aromatic Hydrocarbons
POC .... Parameter Occurrence Code
ppb .... Parts Per Billion
ppm .... Parts Per Million = mg/kg, mg/L, µg/g (1 ppm = 1,000 ppb)
QA .... Quality Assurance
QAPP .... Quality Assurance Project Plan

SASS.................. Speciation Air Sampling System ($PM_{2.5}$ Speciation Sampler)
SO_2 .... Sulfur Dioxide
SOP .... Standard Operating Procedures
STN.................... Speciation Trend Network ($PM_{2.5}$)
Stp .... Standard Temperature and Pressure
SVOC................ Semi-Volatile Compound
SWHS .... Southwestern High School
TAC.................... Toxic Air Contaminant
TEOM................ Tapered element oscillating microbalance (hourly $PM_{2.5}$ measurement monitor)
tpy .... Ton per year
TRI .... Toxic Release Inventory
TSA .... Technical Systems Audit
TSP..................... Total Suspended Particulate
US .... United States
USEPA............... United States Environmental Protection Agency
UV...................... Ultra-violet
VOC .... Volatile Organic Compounds

ACKNOWLEDGMENTS

This publication was prepared utilizing information provided by the Air Quality Evaluation Section (AQES) and other staff of the Michigan Department of Environment, Great Lakes, and Energy; Air Quality Division. Copies can be obtained online at: www.Michigan.gov/Air, under "Monitoring," then "Annual Air Quality Reports," or call 517-284-6747 to request a hard copy.

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MICHIGAN DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY

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(Northwest Lower Peninsula)
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(Northeast Lower Peninsula)
2100 West M-32
Gaylord, MI 49735-9282
989-731-4920 Fax: 989-731-6181

Counties: Alcona, Alpena, Antrim, Charlevoix, Cheboygan, Crawford, Emmet, Montmorency, Oscoda, Otsego, Presque Isle, and Roscommon

Detroit District
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Counties: Arenac, Bay, Clare, Gladwin, Huron, Iosco, Isabella, Midland, Ogemaw, Saginaw, Sanilac, and Tuscola

Southeast Michigan District
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Counties: All counties in the Upper Peninsula